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THE NIAGARA FALLS ACCIDENT.

The deplorable accident at the plant of the Niagara Falls Power Company last week, whereby a number of important manufacturing plants and railways were temporarily stopped, was, so far as we have been able to learn, entirely unavoidable. Lightning unfortunately is yet but little understood, and, as is illustrated by this case, protective devices sometimes fail with disastrous results, though such accidents are rare in modern plants.

Shutdowns Avoided Hereafter.

The accident further emphasizes the danger of concentrating everything into one building. In this great plant every conceivable precaution had been taken to prevent a shutdown, yet a weak point was found. Had the accident occurred a year hence, it is probable that but little inconvenience would have resulted, and when all of the power stations now in course of erection at Niagara have been completed, these will doubtless be able to help one another out in time of trouble.

Task for Engineers.

But we believe that the day is not far distant when the whole problem of lightning protection will be so thoroughly understood that accidents from this cause will be practically unknown. There is, however, still much work to be done, and we are confident that our engineers will find a solution before very long.

THE STEAM TURBINE.

Among the advantages claimed for the steam turbine are three which are of particular importance in electrical engineering. These are the possibility of using highly superheated steam, the uniform rotation and the high speed.

Effect of Speed on Design.

Respecting the last point, high speed is desirable in many classes of electrical work. Heretofore we have been under the necessity of designing machines for low speeds in order that they might be directly connected to reciprocating engines. Generators built for this class of work are generally large and heavy, as this is necessary in order to obtain an economical peripheral velocity. The frames and spiders of these generators then become a considerable part of the whole machine.

Advantage of High Speed.

With the steam turbine on the other hand, the question of design must be approached from a different point. Here the problem is not to obtain high speeds, but to reduce the speed of the turbine to such a point that it may be used to drive the dynamo. It now becomes a question of designing a generator for the highest speeds. Other things being equal, the higher the speed of a generator the greater its output, so that a marked economy in material may be secured by adopting a high-speed drive.

Desirability of Uniform Rotation.

A problem which has received much attention recently is the proper method of operating alternators in parallel. With direct-current machines irregularity in rotation causes simply a slight shifting of the load between the machines. With alternators, however, variation in the angular velocity of the generators causes an exchange of heavy cross-currents which set up undesirable strains upon the machines, and possibly fluctuations in the voltage of the system. The steam turbine, giving as it does, a practically uniform turning effort, eliminates this difficulty.

The Steam Engine an Efficient Machine.

The steam engine of to-day is very efficient as a machine, but the method of transforming energy made use of here is unfortunately inefficient. To increase the efficiency of this method of transmission, we must either lower the lower limit of temperature or raise the upper. The only way by which we can lower the limit reached to-day in condensing plants is to use some fluid other than steam. This plan has been suggested a number of times, but brings in so many complications that it is not seriously considered to-day. The upper limit can, of course, be raised by superheating the steam, but here we encounter other troubles. The limit is soon reached with reciprocating engines, and the question of lubrication becomes more difficult. The steam turbine, having no rubbing surfaces, requires no lubricating of parts which come in contact with the steam, so that it would seem possible to use steam superheated to any practical degree. An incidental advantage of the steam turbine may be mentioned here. Since no lubrication is required in the steam chambers, the steam itself is not contaminated with oil and can be condensed and pumped back into the boilers without purification. This point becomes important in marine work and in districts of the country where bad water must be used.

Slow Introduction of the Steam Turbine.

Although the steam turbine has not lacked for advocates, its introduction has not been surprisingly rapid. This no doubt can be accounted for by the conservatism of the engineering profession. The first types of steam turbine were naturally far from perfect and their performance not efficient. To-day they stand on a par with the best steam engines as regards efficiency, and it only remains for experience to prove their reliability.

THE TRACKLESS TROLLEY.

Electrically operated vehicles, running on the ordinary highways, and which are propelled by power collected from conductors suspended over the roadway, are attracting more or less attention in Europe, and, indeed, have been considered in one or two cases in this country. For this reason it seems well to examine into the merits of this means of transportation.

Cost and Maintenance of Road-bed.

One of the most serious drawbacks in the construction of any railway is the cost of the road-bed. In many cases the right of way must be secured at a considerable outlay. This is then graded, bridges constructed where necessary, and an expensive track laid upon the way thus prepared. Moreover, in addition to the charges which must be made against this investment, the cost of maintenance must be added, and this is always a considerable item of the operating expense. There are at present many sections of the country without adequate transportation facilities because they can not supply the traffic necessary to justify the building of a standard steam or electric road.

Light-Gauge Roads.

Attempts have been made in many instances to get around this difficulty partially by constructing light or narrow-gauge roads; but these have almost, without exception, gone by the board, because the builders, although recognizing that the traffic could not be heavy, still aimed at a road approaching as nearly the standard railroad as their funds would allow. These roads, after a struggling existence, have, in this country at least, been in most cases absorbed by other railways, which doubtless secured them on very easy terms, converting them into feeders for their main lines, the first step in this work usually being to reconstruct the road, making it standard gauge. Some years ago one of our high authorities on railway work made a study of these conditions, and stated that in his opinion there was a profitable field for light railways. However, the builders should recognize the limitations of the district through which it was intended to build, and should construct a cheap road and operate it in the simplest manner possible. Some estimates were made which bore out the opinion given.

Conducting System and Right of Way.

The trackless system avoids all expense for a track and right of way, although in some cases it may have to pay for the franchise to operate over the public highway. Moreover, the conducting system need not be expensive, since the vehicles must necessarily be light, and high speeds should not be attempted. In hilly country objectionable grades may frequently be encountered on the highways, but these should be taken slowly, and in many cases it would be possible to go around them.

Roads of this character which have already been in operation in general consist of a four or six-wheel car equipped with motors, and an overhead system of two wires. Current is collected from these wires by a trolley traveling on them, somewhat after the manner which was tried to some extent in the early days of the trolley road. As will be remembered, this method of collecting in those days was not satisfactory. Among other troubles it was found difficult to prevent the trolley from jumping the wires. Since that time methods of construction have been vastly improved, and when, as today, the collecting trolley for these trackless systems is self-propelled, this serious difficulty seems to have been entirely eliminated. The trolley is run by a small motor, which is under control of the motorman and is adjusted to travel over the wires at the same speed as the vehicle moves along the road.

Boon for Agricultural Districts.

While in a few instances a system of this character might be desirable for a pleasure road through a district where the usual trolley construction would not be allowed, the most promising field would seem to be farming districts, where traffic is light and the needs of the community small. In planning for such a road, the income which can be secured from express matter and hauling freight would probably form a considerable part of this. For this reason it would seem wise to use a rather heavy construction, and equip the vehicle with ample power with a view to hauling one or more trailers containing freight. It would seem to be entirely feasible to haul in this way an ordinary farm wagon between any two points on the road, and this could certainly be done more cheaply than by hauling with teams, and would save the farmer a loss of much time. He would then be under the necessity of hauling his produce to the nearest point of the system only, when it would be taken in charge by the electric vehicle and hauled to its destination. Traveling under these conditions would necessarily be somewhat slow, but certainly better time could be made than by horses, and freight hauling could be limited to certain hours of the day, so as not to interfere with the passengers.

Electric Haulage on Canals.

Electric haulage on canals has been tried abroad, and, so far as we have heard, with gratifying results. In this case, however, the work is of somewhat different character, as the speeds allowable are very low, and no attempt is made to secure passenger traffic. Indeed, canals are suitable only for heavy, bulky freight.

It might be well for some sections which feel the need of better transportation facilities to consider this system before building a much more expensive trolley road. Should it not prove profitable, it would be fair to assume that a trolley road would have met with no better success, and the experiment will have been conducted at a less expense. When the traffic increases sufficiently, the system may then be converted into a trolley road without appreciable loss. The overhead system and the apparatus at the generating station would all be available.

Some time since it was announced that a system of this kind was to be built in California. We trust that this will be done, and shall watch the experiment with much interest.

The change from a combination of rope and bevel gear drive to group motor driving at the works of the Society Cotonniere, Mirecourt, France, shows a difference of efficiencies in favor of the electrical transmission from the engine to the loom, as shown by the indicator readings of 66.8 and 71.7.

ELECTRICAL MINING NOTES.

COAL CUTTING BY ELECTRICITY IN BRITISH MINES—II.

BY SIDNEY F. WALKER.

THE DISC MACHINE.

So far the disc machine is the one which has done most work in long-wall coal cutting. It consists of a wheel or disc carrying cutting tools, chisel shaped, at its periphery. The disc cuts along under the coal, or in the coal, the cutting tools scraping or cutting away the coal or the strata in its way, and bringing it out behind the machine. The disc itself is supported by an overhanging bracket from the side of a rectangular framework, which carries the driving power, gearing, etc. The frame of the machine may be taken to consist of two substantial steel plates joined at the ends by shorter plates, with the gear-wheel shafts supported between the side plates, and the large bracket supporting the disc being from one of the side places in such a position that it can pass along under the coal, while the body of the machine passes along on rails in front of the face. A small haulage plant is also carried by the machine consisting of a cast-iron drum which winds up a steel wire rope as the machine moves forward, the end of the rope being anchored ahead. The electrically driven disc machine is driven by one or by two motors. The general plan is to use one motor of twenty-five horse-power geared to the disc by spur and beveled gearing, the haulage drum taking its motion through further gearing from the second motion shaft. In the Diamond disc machine, however, two motors are employed, each of fifteen horse-power, fixed one at each end of the rectangular frame mentioned above. The shafts of the two motors are connected mechanically, and the motors themselves run in series. The motion is transmitted mechanically from the motor-shafts to the disc by means of spur and beveled gearing, and also to the haulage drum. The Diamond machine has had very considerable success, both in the United Kingdom and on the continent of Europe. Its inventors claim that it presents considerable advantages over the single motor-driven machine. The machine is balanced mechanically, which is of considerable importance. It will run in either direction, and the pressure used in each motor is only half that of the supply service, which is again a most important matter from the electrician's point of view, as insulation is difficult to maintain at the face of the coal. The motors used for disc machines are always fully enclosed, as are also the starting resistances, switch gear, etc. Diamond machines are also run by polyphase motors, two to each machine, as with continuous-current machines. The writer saw a Diamond machine working at the face in a colliery in Yorkshire, which was taking thirty-two horse-power, using polyphase currents, cutting seven feet under the coal, but there was no sign of heat or sparking anywhere. The switch was completely enclosed, and there was no starting resistance, the disc being started away from the coal and worked in.

THE BAR MACHINE.

Great things were hoped from the bar machine, but so far they have not materialized. In this machine, a bar carrying cutting tools, of rather a different pattern to those used with the disc machine, revolves horizontally, under or in the coal, cutting a parallel groove, similar to that cut by the disc. The bar has a reciprocating motion given to it, and behind the bar is an iron plate which is also carried by the machine, and which with the spirally arranged cutting tools forms an archimedean screw, and acts as a conveyor to bring out the dirt, made by the machine. The frame of the machine is very similar to that of the disc machine, but it is more enclosed. The machine is driven by a twenty-five horse-power electric motor, the bar itself running at from 300 to 500 revolutions per minute. Motion is transmitted from the motor-shaft to the bar by spur and beveled and worm gearing, and by this means also the reciprocating motion of the bar is produced. The bar is arranged to turn up or down, so as to avoid obstacles. It usually takes less power than the disc machine but it has not done very well so far, for various reasons, one of which is the fact that the reciprocating motion carries the dust into the gearing, where it destroys the teeth of the gearing. For this reason, when cutting in coal, it does better, coal dust acting partly as a lubricant, owing to the well-known properties of carbon.

THE MORGAN-GARDNER JIB MACHINE.

This machine, as mentioned above, has only lately been introduced into this country, and the writer understands has been worked mainly for the European market, the American mines being worked principally on the stoop and board system (bord and pillar). It is not the first jib machine which has been introduced into this country, but it is the first electrically driven machine of that pattern, and the "Baird" machine, which was also a "jib" machine, has been long since abandoned. It may be described as a chain breast machine with the frame and its chain, taken out from its position, lying longitudinally in the machine, and turned at right angles to the body of the machine. The frame, with the chain carrying the cutting tools, is pivoted at one end of the machine, and it is arranged to swing round this pivot, so that it can be used on either side, enabling the machine to run in either direction, and with either side to the coal face and to cut its way in at stations. It also does not run on rails, as the whole of the other machines do that have been mentioned. It runs on skids, so that the labor of rail setting is done away with. Four jacks, one at each corner of the body of the machine, are provided for setting the machine at any level at which it may be necessary to run on account of the floor. It has a guiding bar, which can be fixed on either side of the machine to keep it from running into the coal. This bar performs the office performed by the rails with other machines. The machine is worked by a twenty-five horse-power motor, which delivers its power to the cutter chain through spur and beveled gearing, and which also provides the power for turning the jib round when cutting its way into the coal, and for the haulage plant which accompanies the machine, as usual worm gearing being used for these. The machine is claimed to be an improvement on the disc machine, as it takes less power, and as it can not be easily stopped by the coal coming down on the frame in which the chain is held. It certainly takes less power than is usual with either the disc or bar machines. The power taken is only from six horse-power to eight horse-power as against from twenty-six horse-power with the bar and from eighteen horse-power with the disc. When the chain comes against any hard matter, such as the nodules of pyrites mentioned above, which are very common in and under the coal in this country, more power is taken. With the "jib," it is claimed, the only power taken is that in moving the chain and in the haulage plant, which is very small. With the disc machine, it is claimed, the whole disc has to be moved, and the friction may be considerable. It will be exceedingly interesting to watch the struggle between the best British practice as represented by the Diamond and Clarke Steavenson machines, and the Morgan-Gardner, which the writer understands represents the latest American practice. On this side, the best work has been done, up to the present, by making the machines powerful enough to go through anything. The writer has met with a case of a disc machine using 100 horse-power for a short time, on meeting with some of the pyrites mentioned. This has been the principle, go through whatever comes. Pull out the nodules. And it has worked well up to the present.

THE PIKE'S PEAK HYDROELECTRIC DEVELOPMENT.

BY J. H. RUSBY.

Articles of incorporation of the Pike's Peak Hydroelectric Company were filed in the office of the county clerk at Colorado Springs, Col., and also in the office of the Secretary of State, at Denver, Col., on December 30, 1902.

The company is capitalized at $700,000, divided into 700 shares of $100 each, and the life of the company is twenty years.

The incorporators are George A. Taff, a well-known consulting engineer, of Colorado Springs, Mining Exchange Building; George M. Brandt and Samuel T. Hamilton, and they, with Henry C. Hall and J. Arthur Connell, will constitute the directors of the company for the first year.

The company is empowered to generate and distribute electricity, and to sell electricity to be used for light, power, heat and other purposes. The principal office of the company will be in Colorado Springs.

The filing of a warranty deed with the county clerk on the afternoon of January 3, in which the Pike's Peak Power Company conveys to the newly incorporated company all its property and franchises, marks the closing steps which enable the new corporation to carry out its plans for the erection of two immense power plants on the east slope of Pike's Peak. According to directors, the project involves the investment of approximately $1,000,000, and it is planned to have both stations in operation by the beginning of next July.

The stations will have a combined capacity of generating 5,000 horse-power. The company purposes despatching immediately a corps of engineers to survey a route for the laying of a new twenty-inch water main, running from Lake Moraine to Manitou to connect with the city intake, which is required according to the terms of the Jackson franchise, which is the one under which the Pike's Peak Power Company has operated heretofore. Under the terms of this franchise, the old company was given the right to extract water power from the city mains along Ruston Creek in return for the construction of this twenty-inch main, and as part payment for the boring of a tunnel through a portion of Pike's Peak, which tunnel conveys the water of West Beaver Creek into Lake Moraine reservoir.

This franchise included a proviso that the water used for power was not to be in any way contaminated.

The new pipe line will be 30,000 feet in length, and when connected with the city main will increase the water pressure about four times.

The company intends to furnish power for lighting and heating purposes to Colorado Springs and adjoining towns. The company has already acquired franchises for the lighting and heating of Manitou.

The present plant of the former Pike's Peak Power Company is situated on the east slope of Pike's Peak, about half a mile below the Half-Way House, on the line of the Pike's Peak cog road.

One of the city's water mains is used, obtaining a pressure of 275 pounds per square inch, driving a Pelton undershot water-wheel, which is direct-connected with a General Electric alternating-current, three-phase, 3,600-volt, twenty-four-ampere generator, with a full speed of 600 revolutions per minute. A separate 125-volt, thirty-six-ampere exciter is used.

This generator was employed some six years ago for generating power for boring the tunnel before mentioned.

Northwestern Electricity and Power Gas Scheme (England).

The Northwestern Electricity and Power Gas Syndicate has been formed in England, and is now seeking to obtain parliamentary powers for supplying electricity in bulk throughout the whole county of Chester, a portion of Staffordshire, Derbyshire, Flintshire and Denbigshire. The company also asks authority to supply producer gas for the purposes of motive power and heating within this area. The proposed sphere of operations has an area of 2,000 square miles, with a population of about 1,500,000, and including a number of important towns. It is claimed that owing to the introduction of Mond gas, gas engines can now be obtained in all sizes up to 2,500 horse-power with throttle governing, giving as little variation as the best steam engine. The company will not compete with gas lighting interests.

Four generating stations are to be erected, one each at Runcorn, Ruabon, Bollington and Stone. The proposed system of charging is as follows: Ten shillings per electrical horse-power, plus a charge for current, as determined by meter, varying from threepence down to three-quarters of a penny per unit, according to the quantity supplied; or fourpence per unit not exceeding an equivalent of 100 hours of supply at maximum power. The price for power gas is fixed at threepence per thousand cubic feet, if not less than 4,000,000 cubic feet per quarter are taken, and fourpence per unit for smaller quantities. The capital of the proposed company is $7,500,000.

Electric Automobiles.

At a recent meeting of the British Institution of Civil Engineers Mr. H. F. Joel read a paper, entitled "Electric Automobiles." After calling attention to the advantages which automobiles have over animal power, the author gave some figures showing what had been done with electric automobiles, these being considered the most satisfactory for urban work. The various parts of an electric automobile were considered, and comparative costs of electric and other motor cars were given. The ratio of weight of vehicle and weight of storage battery was next taken up. A battery of accumulators, weighing six hundredweight, will give ten horse-power-hours, or 67.2 pounds weight of battery for one horse-power-hour. Taking the efficiency of the motor and gear at seventy-five per cent, and assuming the output to be fifteen watt-hours per pound of complete battery, such a battery would convey itself against a tractive resistance of fifty pounds per ton at the rate of twelve miles an hour for a total distance of 250 miles. With a vehicle weighing six hundredweight, the distance that could be run would be 125 miles, and with a load of three hundredweight the distance under the same conditions would be reduced to 100 miles, equal to seventy-five ton-miles. With a load of nine hundredweight, the ton-miles would be the same, the distance being 71.4 miles. The cost of varying the useful load would be for a three-hundredweight load at the rate of 1.8 pence (3.6 cents) per ton-mile, and for a nine-hundredweight load, 0.9 pence (1.8 cents). The conclusion would be that as the load is increased the cost of conveying the useful load per ton-mile was reduced, but the limit was soon reached when the machine must be made stronger to carry the increased load. Curves were given in the paper, showing the ton mileage in conjunction with the ratio of weight of battery and total weight; the ratio of useful load to the total weight; cost of electric energy per ton-mile to useful load, and the relative weights and costs of cars.

Annual Report of the Electrical Department of Cambridge, Mass.

The annual report of the electrical department, Cambridge, Mass., shows that a large amount of work has been covered. The report contains also recommendations in securing a suitable conduit system and an analysis of the financial accounts of the Cambridge Electric Light Company and the Cambridge Gaslight Company from 1890 to 1902, these statistics being given in charts. Some recommendations are made regarding the proper inspection of illuminating gas. The question of telephone rates is also taken up.

THE EVOLUTION OF THE TELEPHONE SWITCHBOARD—II.

BY THOMAS D. LOCKWOOD.

But if we take electromagnets out of the main conductors they will of course no longer oppose the passage of the voice currents in their legitimate circuit, and if we then connect the magnets in bridge between the mains, we no longer need to disconnect them when we unite one line with another, because they still retain the impedance which can be increased to any desirable extent, and because we can then make that impedance useful to prevent wastage of the voice currents through the bridges thus constituted. The disconnecting annunciator had, in fact, as we have already seen, been so connected; and on party lines there were many high impedance "bridging bells," so-called, also in parallel between the mains, which were employed without bringing about any perceptible depreciation of the transmitted speech. So then the first solution came to several minds at once. Why disconnect the calling annunciator at all? Why not disregard it, and leave it connected with the line while the circuit is switched, depending upon its impedance to prevent the short-circuiting of the currents through the annunciator branches thus left intact. This was done, but it became necessary as in the prior case of the disconnecting annunciator to wind the magnets with many turns, and generally to make them of high impedance. There was, however, nothing objectionable in so constructing them, because the higher the impedance, the less chance there was for the voice currents to be shunted that way.

Fig. 4 shows in diagram the talking circuit as thus formed between the substations, the circuits of such substations being switched together under these conditions. In this figure L and L^2 represent circuits extending from substations S and S^2, respectively, to a central station C, and there provided with permanently connected call annunciators A and A^2. They are supposed to be united for conversation by the switch-cord conductors *c*, between which the disconnecting annunciator *d* is bridged. So connected, the line annunciators are obviously bridged also, and thus the through circuit has at the central station three bridges, each containing an electromagnet. Here, then, arises another difficulty. The wanted station must be called by the central station operator after the switch-plug is inserted in the proper line jack; and since the annunciator of the wanted line is not cut off, it will respond unless means are taken to prevent. Moreover, since it may be and probably is at another section of the board, its operation will doubtless be regarded as a call by the operator there, who, of course, will try to answer the supposed call. Again, when the conversation is over, and the substations S and S^2 ring off, the line annunciators A and A^2 are again likely to respond, one of

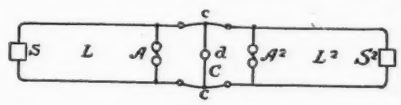


FIG. 4.

them in any event being probably at another section of the board, so that this also will be taken as an incoming call. A number of propositions looking to the avoidance of such false signals were proposed, but the most promising plan for the latter contingency was so to arrange the switch-plugs and sockets, that the insertion of the plug might close a local circuit containing an electromagnet, which magnet would when excited by the closure of its circuit, act to hold the armature of the annunciator in its normal position so that the annunciator could not operate and display its signal, even though a current should pass through its actuating magnet. This device, which is indicated by Fig. 5, worked in fact so satisfactorily that it not only prevented the undesired operation of the annunciator, but also acted to reset the same,

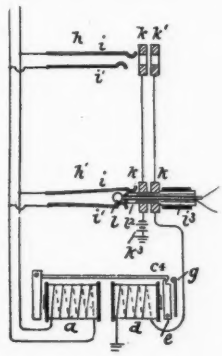


FIG. 5.

when the signal had been given, pursuant to an original call, so that a drop fallen to display such signal did not need to be manually replaced, but was automatically restored as soon as a plug was inserted to answer the call.

In sending outgoing calls over the wanted line, a satisfactory expedient to prevent the operation of the annunciator of the line wanted was so to connect the actuating and retaining magnets, that while incoming call currents passed through the actuating magnet only, outgoing call currents passed through both actuating and retaining magnets.

So many adverse electrical influences were now abroad, by reason of the numerous heavy current systems which had been installed, that the "busy test" arrangement already described was no longer serviceable. Charges and stray currents on the line, due to such influences, tended to produce false busy signals. Accordingly a form of "busy test" circuit never crossed or conductively associated with the line conductors, but altogether local, was substituted. The insertion of the plug for the purpose of switching one line to another was made to close one of two gaps in the local test circuit which was in part formed of the several test rings of each line and the conductor uniting them; and also acted to connect a battery thereto, thus raising the potential of all the test rings of the line at all sections. The other pole of the battery was connected, through the operator's telephone, to the tips of all the calling or companion plugs. Thus, when the tip of such a second plug was applied at any section of the test ring of the wanted line, the occurrence or non-occurrence of a click in the instrument, enabled one to readily infer the engaged or disengaged condition of the said wanted line. As thus modified, a number of switchboards were installed, and the type of apparatus became known as the "branch terminal" switchboard. The talking currents had, through this board, a clear conductive path not liable to be impaired by the presence of jack contacts or other abnormal resistance; and, in fact, without any contacts other than those made at the actual switching points. Thus far, then, a desirable advance had been attained, and the branch terminal or parallel connection switch socket arrangement has remained in use until the present time.

The branch terminal switchboard at first brought commercially to the front, did not provide for the other two desiderata which have been indicated. Yet these were not very far behind. It was more important to provide a central source for substation transmitter supply, common to all or a great number of lines, than it was to provide a similar arrangement for calls and other signals. But it seemed likely that if either could be practically arranged, the other might also be provided for by some modification of or addition to the same means; and in the end, thus it has turned out.

After much consideration and trials,

both experimental and commercial, of many plans, the "how" of an efficient central and common battery system for telephone circuits, and the central and substation transmitters, together with a system of incoming call signals and supervisory signals was, as a whole, devised and decided upon. In it the same central office source of current may be employed for both signals and transmitters. The branch terminal mode of switch socket connection was retained, each socket being composed of a frame piece with a test ring in front, and two or more internal contact springs. At each section are the call devices, and the answering jack for the lines which are to be answered there, and a switch socket for all lines entering the office, there being also a sufficiency of switch cords, each with a switch plug at each end.

The substation circuits were then arranged to be, while at rest, conductively closed at the central station through a battery and call device, and conductively open at the substation; but it was necessary to provide some kind of an operative circuit for the polarized substation bell, as otherwise calls from the central station could not be received; and the plan which seemed most promising, and which has been generally adopted, is to place a condenser between the severed ends of the two line conductors and in series with the bell magnet. By this expedient, while the circuit is open at the substation for a steady current, it is practically closed to the passage of the alternating ringing currents of the central station generator, to which the bell is adopted to respond. There is also the ordinary hook switch, which serves as a support for the receiving telephone when not being used; and as long as the receiver remains in place on the hook the foregoing conditions continue; but as soon as the receiver is lifted from the hook the metallic circuit is closed through the substation telephones and the current of the central battery being thus enabled to flow causes the operation at the central station of the call signal relay.

A small glow lamp serves as the line or call signal, possessing the great merit of being prompt and self-acting, both in display and withdrawal; and in practice is placed in a short local circuit controlled by the call signal relay, which has its magnet connected in the main line, and is responsive to the initial operation of the substation hook switch.

Fig. 6 indicates the arrangement, which, as regards the initial call signal, was now complete; and also illustrates the devices now to be described.

The constantly connected annunciators of the branch terminal board were thus superseded by a relay and a lamp, and the appliances formerly employed to maintain the quiescence of such annunciator were now made, instead, to operate a cutoff relay, by means of which the lamp-operating relay might be cut away or disconnected, and the lamp signal thereby withdrawn, as soon as the call was answered by inserting the switch plug. This cutoff relay has two resting contacts through which the two conductors of the main circuit respectively pass, and in such manner that on the excitement of the relay and the consequent attraction of its armatures, the contacts are parted and the

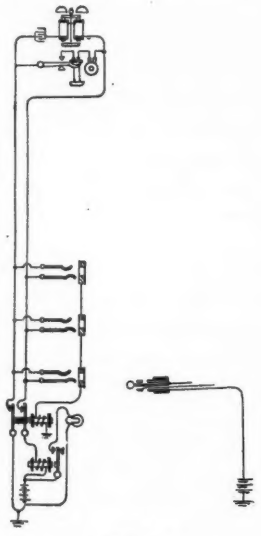


Fig. 6.

continuation of the line, including the call relay and the normal battery connection, is cut off. The cutoff relay itself is in a local switchboard circuit controlled by and leading through contact pieces of the switch plug and socket. The switch socket for this purpose has interior contact springs for both main conductors, thus leaving its frame piece or test ring at liberty for the local circuit; and the several test rings of each line are united by a fixed conductor extending from all of them to one terminal of the cutoff relay. The plug also has three insulated contact pieces adapted to register with the two line springs and the test ring of the socket; the cord conductor extending between each pair of plugs comprising two main-line strands which extend from plug to plug, and a local circuit strand for each plug. A battery has one of its poles connected with the plug local circuit conductor and the other to the remaining relay terminal, so that when the plug is placed in the socket of any line the cutoff relay circuit is closed, and the relay operates to disconnect the line terminal and relay. At the same time the potential of all of the united test rings of the line thus switched is raised to furnish appropriate conditions for the "busy test."

But this is not all. Supervisory signals are regarded as being necessary. These, also, are lamps, and two such are provided for each switch-cord, and associated with the two plugs, respectively, being placed in the cord section of the local or cutoff relay circuit. Thus placed they are, of course, non-operative except when the plug is in its socket; but the plug being thus inserted their function is to afford an indication to the operator of the condition of things at the substation. They can only be displayed when the hook switch at the substation is in its lower or normal position; that is to say, the position in which it is maintained while the receiver hangs on the hook. When in answer to a call the operator inserts the answering plug in the socket of a given line, the associated lamp does not light, because the substation receiver has already been taken from the switch to give the order. But when the companion plug is placed in the socket of the wanted line, the lamp signal of that plug does light, because the receiver at the wanted substation is not removed from the hook; it thus follows that when this receiver is taken up in response to the call, the light is at once withdrawn. Again, when the conversation is over, the replacement of either or both substation receivers will once more illuminate the corresponding lamps to serve as a disconnecting signal. Or if either party desires at once a connection with some other line, the lamps may be made to flash several times in succession by oscillating the hook switch. It must be apparent that such a system of supervisory signals is both ingenious and scientific. Its essential and underlying principle is that the supervisory signal of each plug is controlled in part by the plug and socket switch contacts of the local circuit wherein it is connected, and in part by the hook switch at the substation of the line to which the switch socket belongs; and, further, that the working of the signals is dependent, in the first instance, upon which of these two switch devices was first operated. Thus, in the case of a call being answered by the insertion of the switch plug, the signal is not displayed because the corresponding hook switch has previously been operated; but in case of a substation to be called, the supervisory signal is displayed because

the plug and jack switch is the first to be operated, the hook switch in this case remaining unchanged until after the call is sent.

To enable the hook switch to control the signal, a low-resistance relay is placed in the main circuit conductors of each plug, which relay being thus connected in the main line, is responsive to the closing and opening thereof as the hook switch is moved in one direction or the other.

The sketch, Fig. 7, illustrates this arrangement, and shows that the relay in question does not act directly upon the local circuit of the lamp to open and close the same. This can not be allowed because the same local circuit serves also for the operation of the cutoff relay and "busy test." It acts, however, by controlling a shunt round the lamp signal, closing the

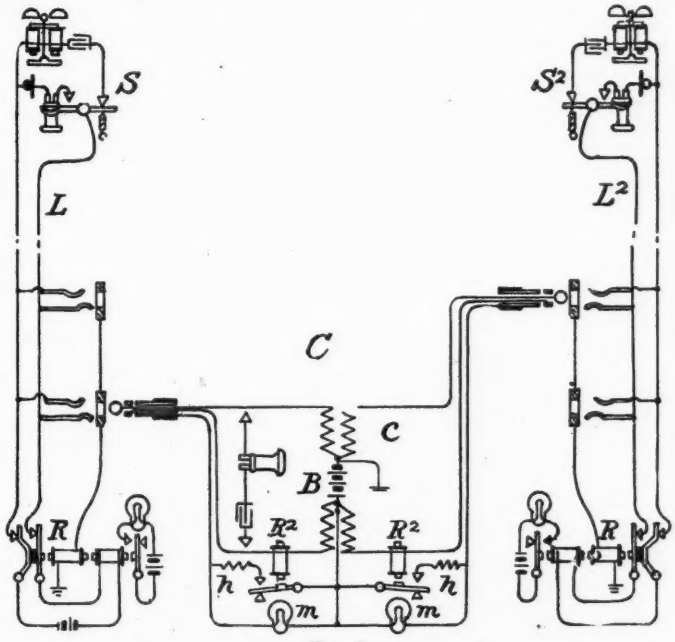


FIG. 7.

said shunt and preventing the display of the light when the main circuit is closed, and current consequently flows through the relay; and opening the shunt to permit the display of the lighted lamp when the receiver at the substation is replaced, causing the hook switch to open the main circuit so that current to excite the relay no longer flows.

In the figure, L L^2 are the substation circuits extending between the substations S S^2 and the central station C, and adapted to be switched together for conversation at the latter. The switch core, *c*, has the battery, B, bridged between its main conductors, and has local circuit conductors for each plug, forming in association with the fixed conductor which unites the test rings, the local circuit; R R are the cutoff relays, R^2 R^2 the supervisory relays, *m m* the supervisory lamp signals, and *h h* their controlling shunts.

The battery which develops the current for the main line to excite the relay is, as shown, preferably bridged between the two main circuit cord conductors, which respectively unite the tip and forward sleeve contacts of the two plugs, and so connected, divides the cord circuit into two well-defined sections looping from each plug. The same battery provided with an earth connection at one pole, may serve also to furnish current in the local circuit to illuminate the lamp signal, and, indeed, also for the operation of the cutoff relay and busy test appliances; the several circuits being properly proportioned to the battery power and to one another by suitable resistances.

Another improvement tending to increased promptness of service in responding both to "call" and "disconnect" signals, is the "pilot lamp." This is an auxiliary luminous signal which may be advantageously associated with both of the foregoing classes of regular signal. It complements the regular signals much in the same way that a bell in a hotel or domestic annunciator system is made common to and complementary to the several individual drops. This pilot lamp is thus common to the signals of a group of call signals, or to a group of the supervisory switch-cord signals, and it is adapted to light whenever any of the regular signals with which it is associated is displayed. It may be placed in a conspicuous position on the front of the switchboard, so as to be readily seen by the monitor or chief operator, and its protracted display is an indication that some signal of the group to which it belongs is being neglected or disregarded; or at any rate, that some signal of such group, thus far has not been attended to. It is by reason of this function that the term "pilot lamp" has colloquially been applied to the device; although I do not say that the term is eminently appropriate. The pilot lamp, like the others, is connected in a local circuit and controlled by a relay, which may conveniently be placed in the circuit of the main conductor through which current is supplied to the branch lamp circuits of the group. This can readily be arranged in several ways without producing such an undue drop of potential in the branch lamp circuits as will adversely affect the regular lamp signals.

When the battery is bridged as has been described, it is properly connected for use also as the source of transmitter supply; and as has been suggested, may be and is so employed in connection, both with the transmitters of the several operators and those of the substations. An important condition of success in the employment of a single battery for a large number of transmitters, is that its internal resistance shall be so low relatively to that of the circuits supplied, that the operation of any transmitter will not cause any material variation of potential at the battery terminals. When this condition is properly complied with, there will not be any interference between the circuits of the several transmitters, and such compliance is best attained by the employment of storage batteries. To further reduce the internal resistance of the battery and the chance of interference, a plurality of banks of cells, each bank having a sufficient electromotive force for the work—say twenty-four volts—may be connected in parallel with each other.

But another condition equally essential in the operation of the substation transmitters of an exchange from a common battery, is that by means of the switchboard devices and in their normal operation, it shall be possible at any time to disestablish this universal state of reciprocal neutrality or non-interference as regards any two circuits, and so to segregate or set aside any pair or any number of pairs of circuits united for through communication, that the component circuits of such pair or pairs may freely communicate each with the other, but shall not disturb, or be disturbed by, any other circuits connected with the battery.

One plan of operation meeting this condition, which to a certain extent has been used, is to introduce a considerable

impedance into the conductors connecting the main circuit strands of the switch cord and thereby the main conductors of the two circuits concerned, with the pole or poles of the battery; and to establish a short circuit, preferably containing a condenser, between the corresponding conductors of the two component circuits, and round the impedance. The steady current of the battery finds no further difficulty in flowing through the impedance devices than that due to simple resistance, and thus readily passes over the line in either direction to the substation transmitters, but can not pass the condensers; while the voice currents developed by the action of the transmitters upon this steady current being in a state of constant and rapid fluctuation, are prevented from short-circuiting themselves through the battery bridge by the interposed impedance coils, but pass with great facility round these coils and through the path which includes the condenser to the distant station.

Fig. 8, however, illustrates an alternative plan which thus far has found more general acceptance. It consists in associating the two united substation circuits L L^2 and the common battery B bridged at the central station between their main conductors, with an induction coil I of the type often styled repeating coils, wherein the two windings i i^2 have a like number of turns and like resistances. The two windings, as is clearly shown in the figure, are connected in the component circuits respectively, so that the circuits are in inductive relation with one another. Both windings are centrally divided, and the bridged battery unites the halves of both on one side to those on the other side of the circuit. Each component circuit is thus supplied separately with battery current for the transmitter of its substation through its own winding of the induction coil; and each is alternately the transmitting and receiving circuit. The voice currents developed by each transmitter circulate in the transmitting component circuit only, but acting through the induction coil they develop substantially identical voice currents in the receiving circuit also, which passing through the same, operate the distant receiver. This arrangement well complies with the second condition of success. It divides the circuit up into two sections, having no conductive connection, and thus tends to minimize the possible effect of a vault which may exist in either; and it reduces the adverse effects which otherwise would be very noticeable when the two lines connected differ considerably in length.

In Fig. 9 is illustrated the application of this plan for central and common transmitter battery operation to the switchboard apparatus; and furthermore, represents in diagram the substation and switchboard connections of two circuits, showing how the same central source of current may be employed in connection with call signals, circuit control and speech transmission.

I may in conclusion briefly advert to a minor improvement which in some installations has been added with a view to further relieving the operator of the time-consuming duty of following up suboperations. This is a device combined with the ringing key, which acts after the key has been manipulated, to lock it in the ringing position with the call generator connected to line for a definite and supposedly sufficient period of time, or until the attendant at the station called, responds by taking the receiver from the hook. One way of arranging such a de-

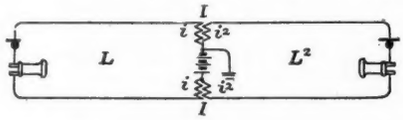


FIG. 8.

vice is to provide a spring latch which when the key is depressed engages a shoulder on the key spindle; to mount the spring upon an armature; and to associate with each key an electromagnet to act upon this armature, the same being wound with but few turns of coarse wire, and connected in the key branch of the generator circuit. The key having been pressed, is thus held in operation, because the current of the generator through the circuit (which, before the removal of the receiver from the hook at the substation is, as we have seen, kept conductively open by the inclusion therein of a condenser), does not excite the releasing magnets. But as soon as the call is responded to by the removal of the receiver from the hook, the circuit is conductively closed; and the generator current now steady and strong, is sufficient to excite the magnet, which attracting the armature, acts to release the key, so that the call current over the line is cut off. Such auxiliary devices, however, and others which have been suggested and which are intended to bring the operators' telephones into connection with a calling line as soon as the plug is inserted, and to disconnect them by an electromagnet switch after the lapse of a definite period of time, or when the companion plug is inserted, or when the call current is sent to the second line, present themselves to my mind, not as essentials of the switchboard apparatus, but as refinements of the lily painting or gold gilding order; which may be employed or not, and which do not alter the general character of the finished machine or effectuate any materially modified result.

There are, furthermore, certain concomitant appliances that have grown up round the switchboard as do suburbs round a city, and which should at least receive mention. These embrace mainly the power-room apparatus for charging the universal storage batteries, and for the generation of alternating currents for outgoing calls; protective devices of several cooperative types interposed between the cable heads and the switchboard to arrest and guard against the effects of various harmful intrusive currents; the main distributing frame, an iron, open-work structure with interior channels through which a multitude of insulated connecting wires are led, and having binding-screw terminals of cable and switchboard conductors on its two sides, respectively between which such connecting wires extend to unite any pair of line conductors to any desired pair of switchboard conductors, and at which any circuit can readily be opened or otherwise altered for testing purposes; and the intermediate distributing board placed between the main distributing frame and the switchboard proper, where all main wires are represented and can be cross-connected, and at which to distribute the business equitably between the operator, any line while retaining its multiple switch sockets can readily be connected or reconnected with any desired answering jack and line signal, and thereby be transferred in a few minutes from any switchboard section to any other, as the fluctuating character of the work may require.

While these appliances, which in every large and well appointed central telephone station are now uniformly provided as accessories of the switchboard, can not, within the reasonable limits of this paper, be discussed in detail; they are, of course, to be kept in mind in planning and preparing specifications for the central station apparatus generally and the switchboard in particular; and their proportionment, design and relation to the switchboard, with which they are to be associated, are matters which in each installation require the most careful and exhaustive consideration.

There is no great invention which has

more thoroughly revolutionized business methods than the speaking telephone. The exceeding value of time is better appreciated now than at any previous period in the world's history; and it is universally recognized that a business man's time is a business man's best asset. Wherever the telephone is employed—and it may truly now be said that "there is no speech or language where its voice is not heard," and wherever the telephone exchange has obtained a footing there at once is a valuable economy of this most valuable possession attained.

It is, however, obvious that to realize this conversation and economization of time to the fullest extent, the possibilities of usefulness inherent in the telephone itself must be competently seconded by a central station switchboard through which all of the several operations and sub-operations requisite for the connection and disconnection of lines, can be carried out with accuracy and celerity. The standard relay switchboard—as the organization of apparatus and circuits whose development I have traced has been entitled—is such an instrumentality; and by it, notwithstanding the marvelous increase of late years in the number of lines entering large central stations, and in the number of calls received and connections made in pursuance of such calls, the speed and efficiency of operation have been not only well maintained, but has exhibited marked improvement.

Here, then, at least for the present, we take leave of our theme. The efforts expended in producing the switchboard which for the time is standard, are amply justified by the general satisfactoriness of its work. True, its organization is complex, but so is that of every poly-functional machine, and why should we object to complexity if accompanied by corresponding efficiency; or unless it shall be proved that the same efficiency can be achieved by simpler means.

The switchboard, though not yet a perfect product of evolution, is at least a complete and successful machine; but evolution still goes on. It may well be that the next step in its never-ceasing progress will be in the direction of simplifying the organization, either in its concrete devices or in its circuit arrangements, without any sacrifice of efficiency.

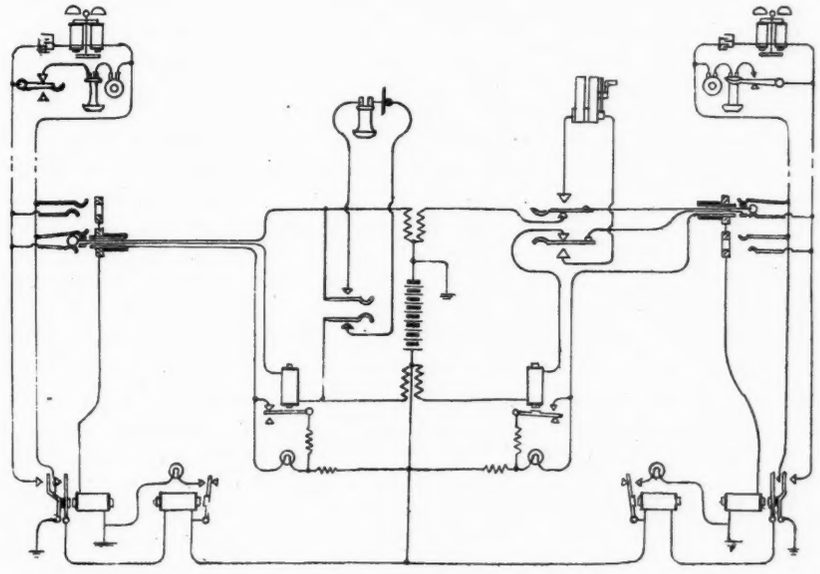


FIG. 9.

Recent Progress in the Electrical Industry in Great Britain.

This is a brief abstract of Mr. Henry Lea's inaugural address to the Birmingham section of the British Institution of Electrical Engineers, December 10, 1902. The dominant note throughout the whole address was that England is not so far behind in the manufacture of electrical apparatus as was generally believed. Statistics were given, showing the output in machinery of the principal British factories for the past five years. The average power of the engines had increased eighty-one per cent in four years. The increase in the total brake-horse-power for the same period was 243 per cent, while the increase in the total number of engines was ninety per cent. Statistics of electrical machinery were harder to obtain than were those for steam machinery; but from such as could be had it was found that the number of machines put out in 1901 showed an increase of 168 per cent over that of 1898, while the output in kilowatts showed an increase of 174 per cent. A noticeable fact of these last few years was the increased use of multipolar machines for continuous currents. Proper attention to design enabled the manufacturers to build these machines so as to obtain efficiencies equal to those given by bipolar machines, while mechanically they were much better. There are comparatively few firms making alternating machinery, but this branch of work is receiving attention. Great as had been the increase in the output of electrical machinery during the last four years, it would have been increased still more if the engineering interests concerned could have arranged for a certain amount of standardization to reduce the number of patterns that the manufacturers had been obliged to make. All manufacturing firms desired to work a jig and templet as far as possible, but in a rapidly developing industry it was not possible to standardize at an early stage. Progress in power distribution was briefly noted. Next to this came traction work, where progress had been more marked than in almost any other branch. In 1901 the increase in mileage over 1898 was 112 per cent, and the increase in the number of cars seventy-three per cent. Concerning the electrification of lines of railways, some interesting observations were made about the ultimate displacement of the steam locomotive. It would die hard. Heretofore railway engineers have not been asked to make high-speed steam locomotives, but that when the demand was made they would do so. It was not thought necessary to fly to electricity for speeds of 100 miles per hour, as already trains pulled by steam locomotives had attained a speed of eighty-six miles an hour, which could be raised to 100 by increasing the diameter of the driving wheels. A fourteen per cent increase in speed would make little difference in the smoothness and steadiness on a first-class double-track road. The use of gas engines for driving dynamos received a passing note. The last section of the address dealt with measuring instruments and the many improvements made during the last four years. Special emphasis was laid upon the improved methods of measuring permeability and hysteresis of iron and steel. At the conclusion of the address Mr. Dudell's oscillograph was exhibited and shown in action. By means of this instrument fluctuations in the electromotive force of an alternator when thrown in parallel with another machine were shown, as well as the synchronizing current.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—IV.

Notes on Progress in Europe and America.

BY JOHN B. C. KERSHAW.

Production and Use of Aluminum in U. S. A.

According to Professor Richards, the Pittsburg Reduction Company is now devoting 15,000 horse-power to the production of aluminum, and the metal is being extracted from bauxite at the rate of 4,500 tons per annum, at the three works owned by this company at Niagara and Shawinigan Falls. This output is equivalent to a production of 0.90 kilogramme per horse-power day of twenty-four hours (on a year of 330 working days), and it is a considerable advance upon the earlier figure of 0.65 kilogramme per horse-power day, which at one time was considered good work.

The greater portion of the American output of aluminum would appear to be utilized for electrical purposes. One of the latest examples of the use of the metal for transmission lines is that of the Shawinigan Falls and Montreal scheme. The line in this case will be eighty-five miles in length; the pressure is to be 50,000 volts, and seven strands of No. 6 wire are to be used for the cable. According to the *Aluminum World,* 240,000 pounds of aluminum will be required for this line, and, at the price of thirty-five cents per pound (thirty-nine cents less four cents discount), the cost of the aluminum will work out to $84,000. Recent sales of the Pittsburg company for transmission lines are reported by the same journal to have been twenty-one miles, twenty miles and 100,000 pounds. Calculating these on the same basis as the above, we have sales amounting in value to $160,000, and in weight to 455,000 pounds, within a few months.

Other important uses of aluminum in the United States are for foundry purposes, for motor car construction and for the manufacture of cooking-vessels and ornaments and novelties of all descriptions.

It has been stated that 25,000 aluminum combs are manufactured per day in the several factories devoted to this one branch of the industry, but this statement must be received *cum grano salis.* A novel use of the metal is for fuse wires on the Niagara-Buffalo 11,000-volt transmission circuit.

Electric Furnaces for the Laboratory.

Several new types of electric resistance furnace for laboratory use have lately been brought to the notice of the scientific public, and as these furnaces can be applied to a variety of purposes, they are likely to become in time a common feature of chemical and metallurgical laboratories. Professor Joly, of Dublin University, and Professor Howe, of Columbia University, have each designed and experimented with furnaces based upon the resistance heating principle, but Heraeus, of Hanau—in Germany—appears to have been most successful in overcoming the special difficulties attaching to this use of the electric current. The earlier forms of the Heraeus furnace were constructed with spirals of platinum or nickel wire, the latter being used only for temperatures up to 1,000 degrees centigrade. The spirals were wound upon a thin porcelain cylinder, within which the crucible, or vessel to be heated, was placed, while the cylinder bearing the spiral was protected on its outer side from the effects of radiation by a protective coating of asbestos, ground quartz or other non-conducting medium. In the later types of Heraeus resistance furnace the spiral of wire has been replaced by one of very thin foil. The advantages claimed for this substitution of foil for wire, are (1) a much higher efficiency as regards transfer of heat to the porcelain cylinder, and (2) a much lower first cost, especially when platinum is used. The furnaces are constructed of various sizes, for heating either crucibles or tubes, and temperatures ranging up to 1,500 degrees centigrade can be attained and maintained with a minimum of trouble and personal discomfort. It is claimed for these new furnaces that not only do they simplify many laboratory heating processes, but that certain difficult thermal operations, as, for instance, the determination of the melting points of metals, can be carried out with ease by their use. It is also stated that they may be used for organic elementary analysis, in place of the old form of gas combustion furnace.

Electrolytic Chlorates.

The electrolytic chlorate industry is at present suffering from overproduction and low prices, and, as I pointed out in the long illustrated article which appeared in the ELECTRICAL REVIEW on October 4 and 11, the owners of several of the older factories are turning their attention to the production of other salts of high oxygen value. Those who still devote the larger portion of their available power to chlorate production will be obliged to work at the highest attainable efficiency if profits are to be made in the manufacture. It is therefore imperative that the managers of electrolytic chlorate companies should keep themselves informed as to the researches and investigations carried out in the laboratory relating to the chemistry of the process which they operate on an industrial scale. For this reason abstracts of the more important researches dealing with the theory of the electrolytic chlorate process were included in the article referred to above, and I now amplify this summary of recent research by adding an abstract of the results obtained by Foerster and Muller in an investigation of the behavior of hypochlorite solutions during electrolysis (*Zeits. f. Elektrochemie,* August 28 and September 4, 1902). This investigation is of importance to makers of electrolytic chlorate, since hypochlorite is always present during the early stages of the electrolysis of sodium or potassium chloride solutions, under the conditions obtaining in the chlorate cell. Foerster and Muller's investigations have led them to the following conclusions:

1. When equi-molecular solutions of NaOH, NaCl and NaClO are electrolyzed with gradually increasing electromotive force, the attainment of a fixed current density is gained with the lowest electromotive force at the anode in the case of NaOH, and with the highest electromotive force in the case of NaCl.

2. In hypochlorite solutions the anode potentials lying between these two extremes are marked by the separation of Cl′ ions.

3. At the moment when anodic discharge of these ions occurs ClO′ ions are formed and oxygen is evolved, probably as the result of the following reaction:

$$6ClO + 3H_2O = 2HClO_3 + 4HCl + 3O$$

4. This anodic formation of chlorate occurs not only in solutions containing free hypochlorous acid, but also in neutral and alkaline hypochlorite solutions.

5. Concurrently with this reaction, a primary formation of chlorate can occur, as when ClO′ ions meet anodic oxygen at potentials above 1.1 volts. This formation of chlorate may be represented as follows:

$$ClO' + 2O = ClO_3.$$

This formation is, however, only of limited extent.

6. Secondary chlorate formation occurs during the electrolysis of hypochlorite solutions when free hypochlorous acids can exist in the electrolyte; *i. e.,* when the electrolyte is kept in an acid condition.

The practical significance of this investigation is seen in the fact that Lederlin, of Chedde, has patented the continuous addition of dilute hydrochloric acid to chlorate cells during the electrolysis, and also in the statement that Messrs. Corbin & Cie., at their Chedde works, have doubled the efficiency of the cell process by careful attention to the scientific side of the manufacture.

THE DESIGNING OF TELEPHONE APPARATUS—XVI.

BY W. A. TAYLOR.

By the term multiple jack is meant a jack which is used in a multiple switchboard. When a switchboard grows to such a size that the connections become slow and complicated, owing to the calls having to be transferred over trunks from one position to another, it then becomes necessary to have a switchboard which does not require such a procedure. In a multiple switchboard all the jacks of all the lines of an exchange are in reach of any operator. The board is arranged in sections with three operators' positions in each section, every line terminates on a jack. Each operator, however, has the usual number of signals to answer. It is seen that with any operator any of the lines is within her reach, either directly in front or on the position to her right or to her left.

These jacks must therefore be of such size and so arranged that all of them may be in the smallest space possible, both as to width and height. In order to obtain such results the jacks are usually arranged in strips of twenty or more, the strip being as narrow as permissible and the jacks as close together as their size will allow. A great deal depends upon the arrangement and number of springs whether a jack can be made on close centres. Until recently there were no boards made with jacks closer than one-half inch. This would permit of a switchboard with a capacity of 6,000 lines. Improvement in apparatus and the demands of larger exchanges have reduced the spacing to seven-sixteenths, three-eighths and, finally, to three-tenths of an inch. With the last size there are but two contacts to the jack. It looks now as though the size would reach one-quarter inch. It is not so difficult to make the jack on small centres, but two exceedingly difficult problems present themselves to prevent making the jacks on such small centres. Where there are exceedingly large-sized boards demanding the small jacks, the cables connecting them become excessively cumbersome and hard to handle. It is also a great problem to make connecting plugs strong enough to stand the work. The plug handles must be a trifle less in diameter than the spacing of the jacks.

THE PLUGS.

The plugs for connecting lines together have been reduced to a standard so that with good construction all plugs are about the same, varying only in details. There are three kinds commonly used: (1) The single plug; (2) the double plug, and (3) the triple plug. The former style has about passed out of date, as all modern boards are metallic circuit. These plugs were used on the old "grounded" boards. Fig. 45 shows about the construction. The plug is turned from the solid brass rod. A is the portion which is inserted into the jack. This portion has a depressed place, B, within which the spring of the jack drops, thus preventing accidental withdrawal. C is a rubber or fibre sleeve, preferably the latter because stronger. The back end, D, of the plug is drilled and threaded. The thread is made so that a tight-fitting cord may be screwed in. The threads hold the braid of the cord and prevent strains on the tinsel. One side of the plug is milled out so as to get at the screw and washer, F, which secures the conductor of the cord.

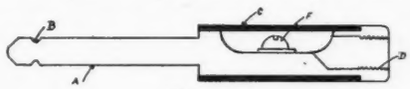


FIG. 45.

Fig. 46 shows a section of a double plug. This is, of course, somewhat more complicated than the single plug. The sleeve, A, and the body, B, are made of one piece of brass. The tip, C, usually of brass, is screwed upon a steel pin, D, which passes through A, being insulated by the hard rubber tubing, E, and washer, K, so that it will not come into electrical contact with the sleeve. D then screws tightly into the connecting block, F. This connecting block is also insulated from the body of the plug. The cord conductors fasten under the screws and washers, H and G; H being fastened to the connecting block, F, and G to the body and sleeve of the plug.

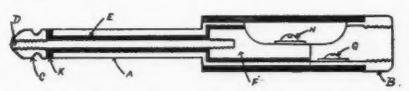


FIG. 46.

Fig. 47 shows the section of a triple plug. In this style there are three conductors known as tip A, ring B and sleeve C. The tip A is screwed on to a steel pin which runs back through the hard rubber insulating sleeve, E, to the connecting block, D. The connecting screw is fastened to this block D, and in order that the cord conductor may not touch the connecting block, F, an insulating washer, G, is placed under the screw and washer, H. The insulating washer is made large enough so that there will be no stray strands to short-circuit the plug. The ring, B, is made from brass tubing, and as shown passes back through the insulating tube, K, to its connecting block, F, within which it is screwed; the connection is made to the ring under the screw and washer, L. The sleeve connection is made by bending back one of the conductors, when the cord is screwed into the shank of the plug. The strand is thus pinched tightly against the threads making a good connection. The steel pin in the centre, connecting the tip, should be soldered into the connecting block. Then after the tip is screwed on, this end of the pin should be upset to prevent the tip from becoming unscrewed. If this precaution is not taken the tip will come off and get lost in a jack and cause trouble on the line. It is needless to state that all insulation on a plug should be of rubber except the fibre sleeve, M. The usual material for plugs is brass, and this should be as hard as is convenient to work in order to prevent undue wear; some plugs are made with steel tips and give good satisfaction where they are used enough to keep them bright. It is, however, always better to use some metal which will not cut the springs in the jacks. It is better that the plug should wear out before the jack. If the plug cuts the German silver springs the fine metal dust is apt to cause insulation troubles. All plugs should be so made that when new they are of uniform length and diameter. They should go into the jack easily and not tight, but should not have any tendency to wiggle.

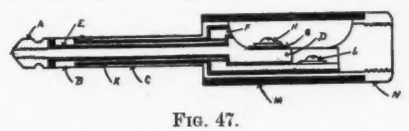


FIG. 47.

The hole in the shank should be of such size that a standard cord screws tightly into it. The threads should not have sharp edges or the braid and the conductor which is bent back will be cut. Great care must be exercised to have all tools for manufacturing the plug made accurately and so placed in the screw machine that all parts will be absolutely interchangeable. If this is not done the plug will be a miserable failure. Only the highest grade of rubber must be used, as other grades are too brittle. As the rubber parts are very thin they call for as strong a grade of insulation as possible.

The British Institution of Mechanical Engineers held its monthly meeting on December 19, at which a paper was presented by Mr. J. M. S. Williams on "Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands." The paper was a plain, straightforward account and was well received and discussed at length.

THE GLOBE COPPER DISTRICT, ARIZONA.

SOME RECENT NOTES ON AN IMPORTANT COPPER DEPOSIT.

Dr. Frederick Leslie Ransome, in professional paper No. 12, United States Geological Survey, makes some interesting points on the geology of the Globe copper district of Arizona, particularly the Globe quadrangle.

The area within the Globe quadrangle contains about 250 square miles and is situated in the southeast-central part of the territory of Arizona, between the Gila River on the south and the Salt River on the north, and includes portions of Gila and Pinal counties. The town of Globe, with a population of about 1,500, lies near the eastern edge of the quadrangle, and is the terminus of the Gila Valley, Globe & Northern Railway, a branch line about 130 miles long, connecting with the Southern Pacific Railway at Bowie. The principal drainage of the district is northward through Pinal and Pinto creeks into Salt River, a small area draining south into the Gila River.

The Globe district lies in the heart of the mountain region of Arizona. The Pinal Range extends southeast to northwest across the quadrangle, occupying, with its flanking slopes, about five-sixths of the total area. These mountains culminate in Pinal Peak, 7,850 feet above sea, and about 4,370 feet above the town of Globe, situated on Pinal Creek in the valley between the Pinal Mountains and the Apache Mountains to the northeast. From Pinal Peak the southwestern boundary of the plateau region is clearly visible some seventy miles to the northward, while to the southwest the eye sweeps over the Dripping Spring and Tortilla ranges, with many subordinate rocky ridges, to where the reservoir at Florence flashes in the afternoon sun, on the borders of the desert region.

In the year 1874 a party of prospectors, having crossed the Pinal Mountains from the west, located the Globe claim, now part of the Old Dominion mine. The Silver King mine, about nineteen miles south-southwest from the present town of Globe, was located by members of this same party as they were returning to Florence.

The future prominence of copper as the principal product of the Globe district appears to have been at first unsuspected, in spite of the strong surface indications of the presence of copper ore, and those mines which subsequently became the largest producers were at one time worked for silver. The first notices of copper prospecting are in the *Arizona Silver Belt* of July 11, 1878, where reference is made to the abundant copper ore revealed by the very superficial working on the Globe and Globe Ledge claims. This ore seems, however, to have attracted little serious attention until 1881. By May, 1884, the Globe mine, from this time on generally known as the Old Dominion mine, was in full operation; and its total production from 1802 to September, 1886, is given as 22,800,000 pounds. There were in all six copper furnaces in the district, and mines other than the Old Dominion are credited with a total production of 1,000,000 pounds for the same period. In 1898 the railroad reached Globe.

In the Globe district the production of copper far exceeds in importance that of any other metal. Up to the close of 1901 the total production of the quadrangle is estimated at about 120,000,000 pounds of copper, of which the Old Dominion mine produced more than three-fourths. Statistics of the output of gold and silver are lacking.

The ores of the Globe district may be classed as free gold ores, native silver or silver-lead ores, both of which play an insignificant part in the mining industry of the region, and cupriferous ores containing varying amounts of the precious metals. It is to the copper ores that the district owes its life. The copper ores may be divided into oxidized ores and sulphide ores. To the oxidized ores belongs nearly all of the ore produced in the district up to 1901. Sulphide ore, with occasional exceptions, is practically of recent discovery, and is a factor of increasing importance in determining the future of mining operations in this district.

THE ECONOMIC VALUE OF TESTING.

HINTS OF VALUE FOR CENTRAL STATION OPERATORS.

At the recent convention of the Northwestern Electrical Association Mr. George D. Shepardson presented a brief paper on the "Economic Value of Testing." In the course of this paper the author made the following interesting suggestions: The manager of a manufacturing plant should know how much product he manufactures, how much it costs per unit, how many units he sells, how many are lost somewhere between the raw materials and the finished product, and how many are lost or stolen between the factory and the customer. A careful inspection of these conditions would, the author thought, make the balance considerably in favor of the company for the year's work. Applying this to the operation of a central station for the manufacture and marketing of electrical energy, it is desirable and economical to keep a systematic record of the amount of raw material used, namely, the amount of fuel, water, oil, carbons, lamps and other supplies; the output of the factory, *i. e.*, the kilowatt-hours produced, and the amount sold.

The relation between the station output and bills rendered shows the proportion of goods lost or stolen in transit. The relation between the amount of raw material and the station output furnishes a basis of comparison with the performance of other like interests, and shows whether the cost of manufacture is reasonable.

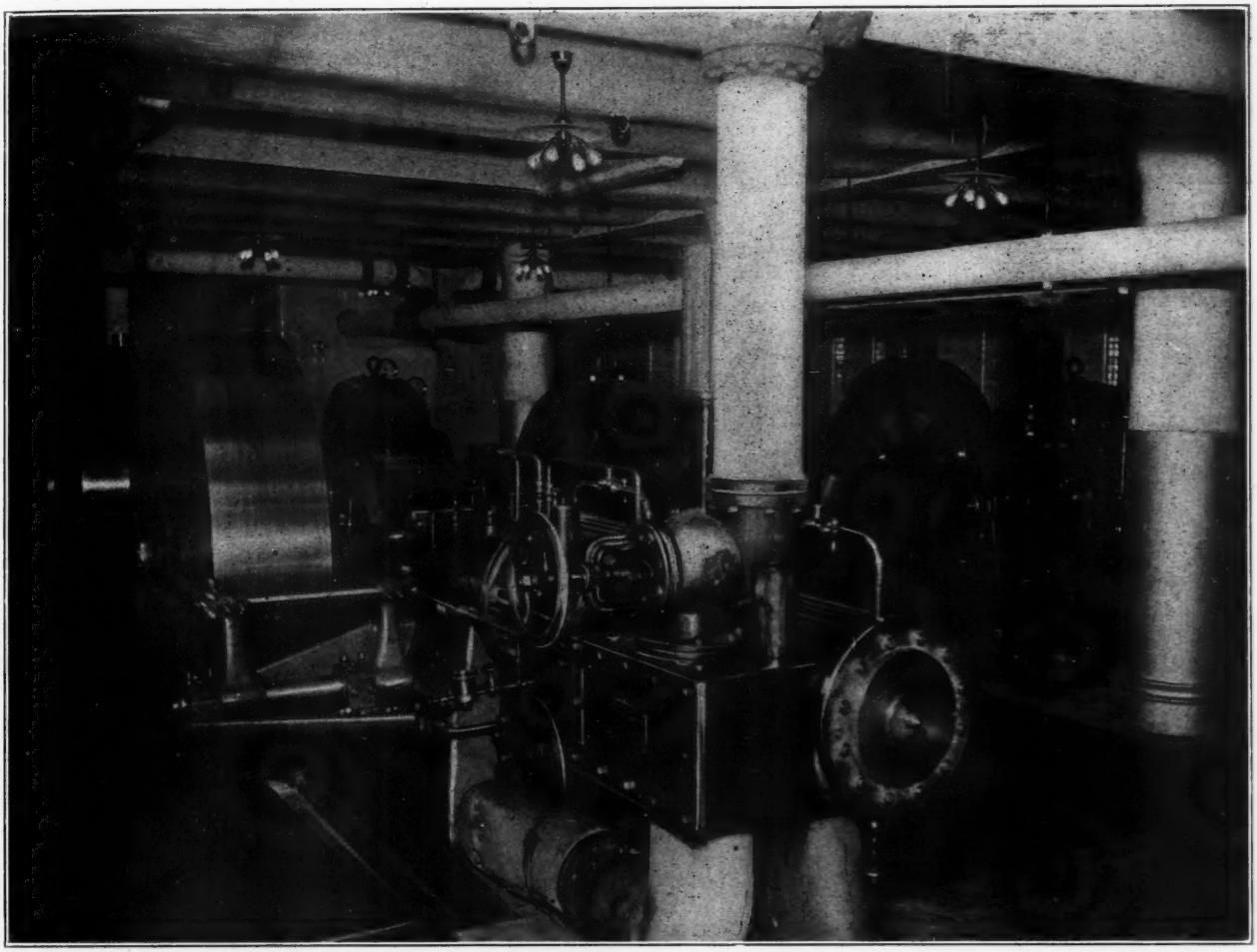
All of this information can be obtained only by testing. Every station does such testing to a less or greater extent. Where one man is superintendent, engineer, fireman, operator, lineman, trimmer, wire-man, meter-man, collector and general trouble man, the amount and quality of testing are necessarily limited. In larger stations, where the responsibilities are differentiated, greater attention can be paid to details, and a larger amount of testing is practicable. The larger companies find it practicable and economical to maintain an elaborate testing department, with one or more experts who devote their chief energies to systematic examination of all the parts of the business, seeing that everything is kept in the best possible condition. Many of the smaller independent companies are finding it profitable to engage the services of consulting engineers to make periodical examinations of their properties for the purpose of indicating leaks and economies. The testing department should be developed with discretion. It would probably be a paying investment for almost any company to engage an expert engineer to examine its property for the purpose of pointing out sources of loss.

A considerable part of the testing can be carried out without any instruments other than a good eye directed with judgment, and a knowledge of what is correct modern practice. Too much importance can not be given to frequent and thorough inspection of the entire system by the superintendent or by some other person whose eye will notice apparent defects.

Modern Equipments for the Conversion of Loft Driving.

Five Old and Separate Structures Supplied with Power and Light from One Compact Plant.

AT THE present time the subject of machine driving is receiving a goodly amount of attention from many prominent engineers. Active as the agitation for the use of electricity has been, and notwithstanding the admitted economy of operation with the electrical drive, there has not yet come about the widespread acceptance that this method undoubtedly deserves.



THE ENGINE ROOM OF THE E. W. BLISS BUILDING, EAST TWENTY-THIRD STREET, NEW YORK CITY.

Leaving the equipping of new plants out of consideration in this instance, the number of old plants which are in existence and will bear an easy conversion from main-belt-from-floor-to-floor drive to a combination of motor and belt drive, is well worthy of attention. In every large manufacturing city there are many buildings in which are carried on as many different industries as there are lofts or floors in the structure.

In New York city this is particularly the case, and this condition leads up to an interesting problem. By far the greater number of these buildings are owned either by individuals or corporations who have nothing whatever to do with the power used in the building but to generate it and sell it in connection with the rental of floor space. The general power scheme consists practically of a prime mover in the basement or cellar of the building, the power being transmitted from floor to floor either by means of heavy counter belts or by a heavy vertical shaft running the entire height of the building. That this method is wasteful of power is conceded, and the chapter of accidents and breakdowns due to loose belts and burned-out friction clutches is a volume in itself. The owner of the building, however, rarely does more than supply power to some convenient point on each floor, and the tenant usually places his machinery in such positions as will best suit his own ideas with reference to his own product. He installs a certain number of machines, which he assures the owner will require a certain amount of power to move. This figure is computed by some convenient formula and proved to be about right, and the tenant pays for power on this assumption. It need hardly be added that the tenant gets at least one-fourth of his power for nothing.

In this way the owner is carrying a double burden unnecessarily. Not only must he provide effective power to overcome the friction of the floor-to-floor shafts, but after he has delivered all the power required to drive the machinery on a certain floor, his paid-for horse-power and his delivered horse-power are at a variance, and he is in most cases the loser.

That tenants are willing to pay for

ONE OF THE ENGINE UNITS, SHOWING THE SWITCHBOARD.

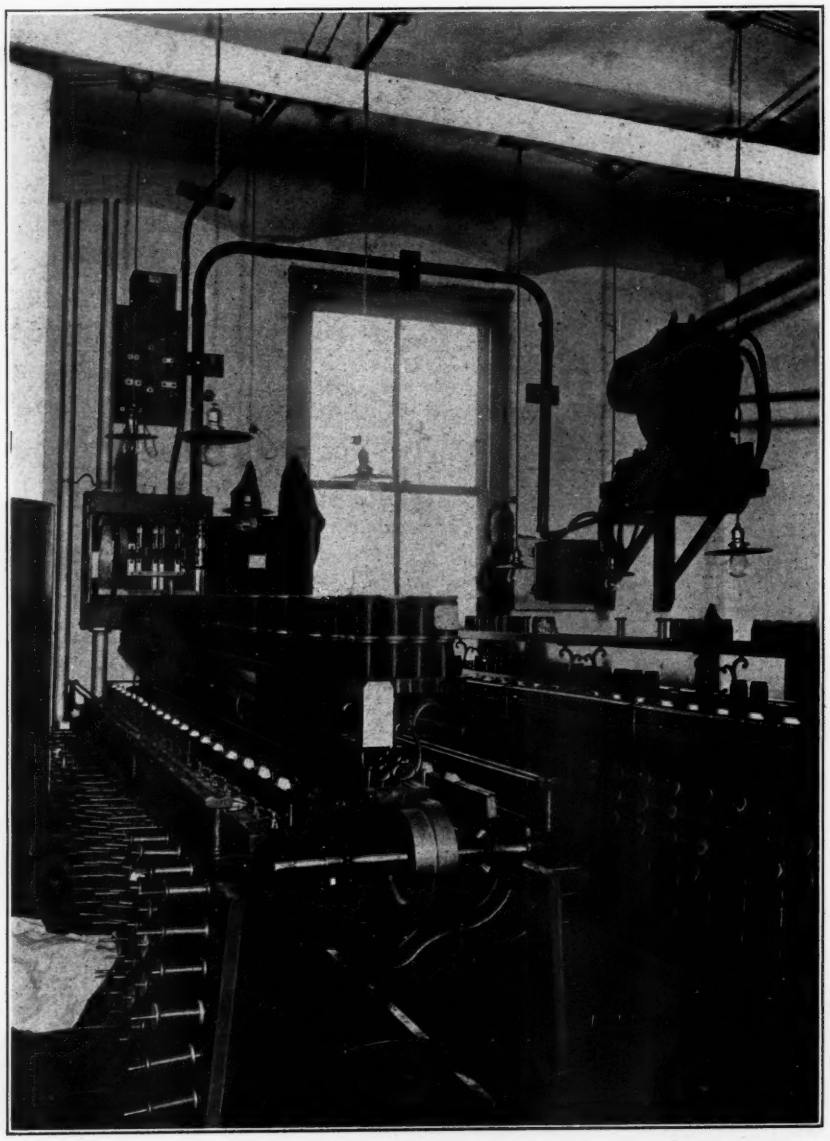
what power they use is admitted; but with the all-over belt drive there is the greatest difficulty in accurately rating each tenant's service. With the installation of a motor drive and accurate wattmeters, this becomes practicable, and there is at once a permanent equity established between consumption and supply.

With installations such as this, where so many different industries are going on under one roof, and each is controlled by individual and separate interests, the question of a suitable method of conversion has to be worked out to effect the joint convenience of both tenant and owner. While the ideal method of machine driving would be that of a unit motor on each machine—assuming speed control to have been positively accomplished—to put into effect so radical a change would be unthought of by the owner of the building. Until the time comes when the tenant buys his machine equipped with a motor as a part of the apparatus, it is hardly likely that the owner of the building will put in a network of wiring with floor and wall pockets for convenient connection.

The great flexibility which comes with the use of electricity, however, may be taken advantage of with the assurance that if it be used simply as a means of eliminating the floor-to-floor shafting it will accomplish a most important gain in economy. Where it becomes desirable to generate power in a centrally located building for delivery to a series of other buildings more or less separated, it is the only means by which many mechanical difficulties can be overcome.

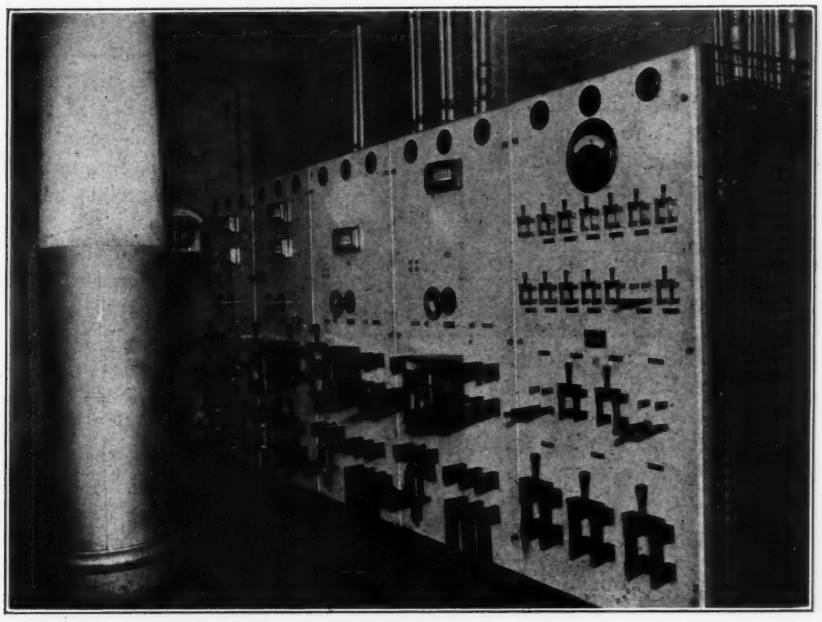
A typical instance of the elimination of line shafting from floor to floor, and of the great flexibility of power delivery, is found in the new installation of the E. W. Bliss Building on East Twenty-third street, New York city, and the subsequent conversion from belt drive to motor drive in a number of other adjacent buildings. A description of this installation has been secured through the courtesy of Mr. Edward R. Knowles, of New York city, the consulting engineer, under whose specifications the new equipment was installed and the power conversion instituted.

Prior to the construction of a new modern ten-story building on Twenty-third street, the E. W. Bliss buildings consisted of two six-story buildings on Twenty-third street, and three buildings, two of five stories, facing on Second avenue and Twenty-second street, and the other,

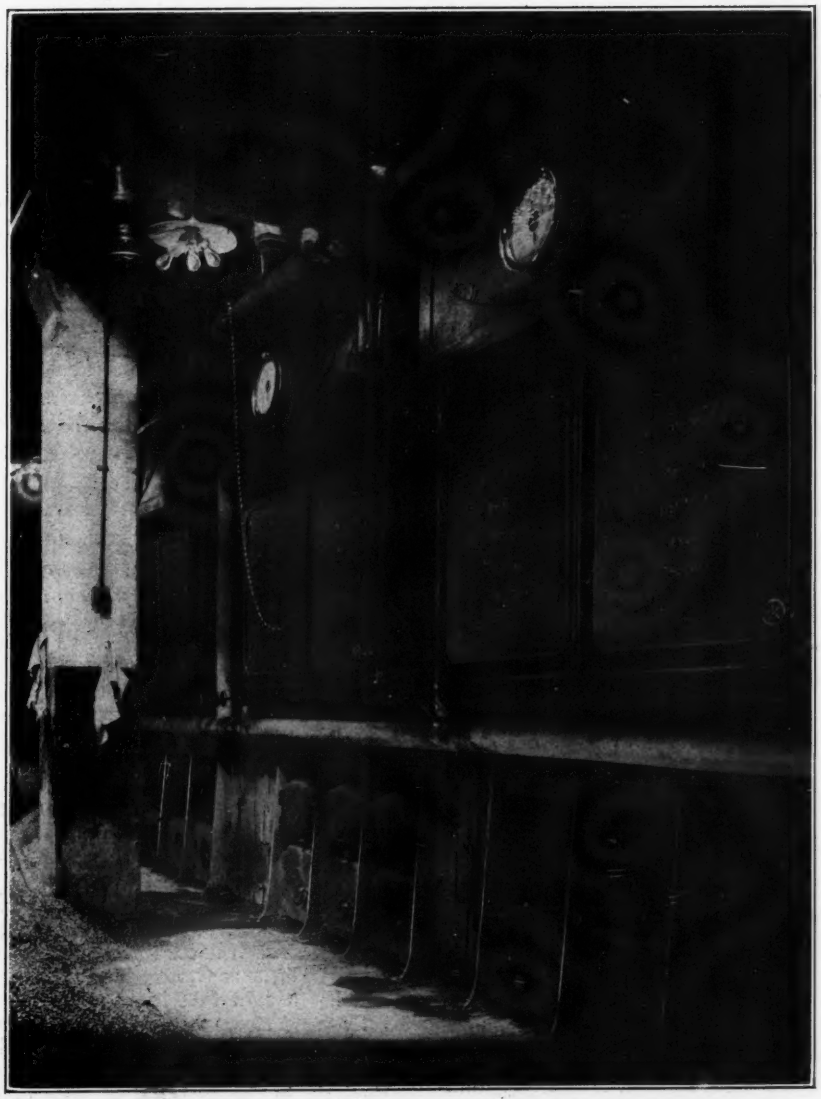


A TYPICAL FLOOR ARRANGEMENT, SHOWING THE CONDUIT, TERMINAL CABINET, WATTMETER, STARTING BOX AND MOTOR.

of six stories, adjacent on Twenty-second street. These have all been occupied for some years by a number of factories producing a very wide variety of materials. The proposition, with the building of the new structure, was to locate in this a power plant which would furnish power and light for the building proper, and also provide power and light for the other five buildings. The dimensions of the floor plan of the new building made it necessary to comprise in an extremely small space an aggregate of machinery which would develop 1,000 horse-power for the lighting and machine driving necessary for the six buildings. The accompanying illustrations show some of the features of this installation. Beginning at the front of the building on Twenty-third street, the coal is delivered to a large bin directly through the manholes in the sidewalk, the doors of this bin being directly opposite the front of the boilers. In the boiler room are located four Heine safety boilers, each of 250-horse-power capacity. In connection with the boilers the Parsons system of forced draught is used. Behind the boilers, and between the boiler room and the engine room, are the necessary pumps for the tank and sprinkler systems, the steam heating system, the feed-water system for the boilers, the feed-water heater, separators and other steam apparatus. The Webster system of heating is used throughout the buildings, installed by Donnelly & Merritt, of New York.



THE SWITCHBOARD, PANEL AT RIGHT IS FOR HOUSE CIRCUITS.



BOILER ROOM, THE COAL BIN IS DIRECTLY OPPOSITE THE BOILERS.

Beyond this is the engine room proper. The floor of the engine room is considerably higher than that of the boiler room. In the engine room proper there are installed four Ball & Wood tandem-compound, high-speed engines, direct-coupled to Sprague generators of 150 kilowatts capacity.

On the north wall of the engine room are located the various steam gauges and meters, and on the west wall, as may be seen from the illustration, is located the switchboard. The switchboard consists of five panels—four for the switchboard proper, the end one being used as a distributing board for the building. On each of these panels are mounted ammeters, voltmeters, the necessary switching apparatus, bull's-eye flush pilot lights, green for the generator circuits and red for the feeder circuits. In addition to the ammeters and voltmeters, at the end of the board is mounted, on a spring bracket, a double-

reading voltmeter with an illuminated dial, the scale being so arranged that zero is in the centre, and reading both right and left to 300 volts from the zero point. This voltmeter is so connected to the switchboard wiring that it can be used for paralleling the generators. The back of the board is so arranged that each of the bus-bars may be connected in series, so that as many of the generators as are running may work on one main circuit; or each of the individual panels can be cut in or out singly, so that one generator can take care of one or more buildings should occasion make this necessary. From the main bus-bars the power and lighting circuits for the adjacent buildings are led underground through highly insulated iron pipe conduits. The system of wiring is the continuous loop throughout. Where the feeder wires for both the lighting and power circuits enter the adjacent buildings, they are carried vertically alongside of the walls in iron conduit to cabinet terminal boxes. From these terminal boxes the circuits are distributed to each floor, where the proper connections are made to a recording wattmeter and to an automatic overload and underload starting box, which controls the motor. One of the illustrations shows very clearly the terminal box, with the leads running to the wattmeter and making the starting box and motor connections. This illustration is typical of the arrangement of each floor. The entire wiring installation was executed by the Tucker Electrical Construction Company, New York city, and the switchboard by the Walker Electric Company, Philadelphia, Pa.

There are in the six buildings about fifty Sprague motors used. These are of three sizes—ten horse-power, twenty-five horse-power and one of fifty horse-power. These are used for group driving of such varieties of service as the making of metal castors, candy-making plant, several printing and lithographing firms, a silk-weaving establishment, briar pipe cutting, a steam laundry, metal cornice work, gas fixture works, and piano-wire manufacturing.

In making use of the flexibility of the electrical system, the engineer has done away with a very large amount of line shafting which was heretofore used in transmitting the power from floor to floor, and also eliminated two steam power plants previously required to supply the power for operating the machinery in the old buildings. An elaborate lighting system has gone hand in hand with this conversion, and the economy already resulting has made the change a very satisfactory one.

The Westinghouse Dinner in London.

On the evening of January 9 Mr. George Westinghouse entertained at dinner a large company of British railway managers, financiers and scientists at Claridge's Hotel, London, England. Two speeches were made, of unique interest. One of these was by Lord Kelvin—the other by the host of the occasion.

In the course of his remarks, Lord Kelvin said: "I am sure that Mr. Westinghouse's coming to England reminds us all of the advantages that England has derived from his genius and perseverance and skill in bringing out for the public good so many of the results of science and inventiveness. There are many railway men present at this table, and many passengers by railways, which means that every inhabitant of our country is represented here. When people belonging to these two classes—the railway men and the traveling public of Great Britain—are gathered together as now, we can scarcely see Mr. Westinghouse without feeling how much we owe to him for the Westinghouse brake."

Lord Kelvin then went on to remark upon the great part which Mr. Westinghouse had taken in the development of the electric industry in the United Kingdom. A large part of the growth of this development belonged entirely to him. Particularly was he responsible for bringing into England and causing to be appreciated there American methods of engineering and American methods of industry and resolution and determination.

In responding, Mr. Westinghouse thanked his distinguished scientific friend for the complimentary language he had used. He also stated to the railway men that his life had been very much associated with their calling. The brake of which Lord Kelvin had spoken he had invented when he was scarcely twenty-one years old, thus becoming acquainted with railway men when the railway interest was rather a poor one compared with what it is to-day. Since then he had closely followed railway operations, becoming acquainted with almost everything that had been done, and it was particularly his friendship with railway men which prompted him to go forward in the work with an interest and keenness that probably would not have resulted from ordinary commercial motives.

He spoke of coming to England some thirty years ago, and for the following ten years being there about half the time. At this time, he said, it was very difficult to get any new thing done in England. He often felt very much discouraged because he could not get any one to believe in anything. He wanted in those early days to try an iron brake shoe because, on account of rapid wear, a wooden one could not be kept adjusted. He had to beg to be permitted to put a set of metal brake shoes on one tender on the Caledonian Railway. Finally he succeeded, with the result that to-day all the railway shoes or blocks are made of cast iron or other metal, and are used upon all the wheels of the train.

In referring to Lord Kelvin's allusion to American methods, he said that one of the English difficulties is inherent in an old-world highly developed country. After a man or nation has worked prosperously for a long time he opposes any suggestion, thinking: "What I have is good enough; I won't try a new thing." In America, however, the necessities have produced different results.

He then spoke of the short-handedness that America has often suffered with regard to labor, and the obligation that managers were under to find methods whereby one man might accomplish the work of two or three men compared with foreign practice. He quoted Mr. Charles Schwab as a genius in the management of men. As a result of the progressiveness which this young man represented, the splendid mills at Homestead are a practicability, where they produce, with about 4,000 men, three times as much steel as the Krupp works produce with 15,000 men. He then described the automatic machinery obtaining in the steel mills at Homestead, and of the conclusion to which several English visitors had come in watching the wonderful precision and possibility of automatic work there. He referred to these conditions simply to illustrate the immense advantage which was had in America and the kind of experience which he had been able to bring to England, and to which Lord Kelvin had so generously alluded. He hoped that this would not only be useful and profitable, but would establish for the company he represented a name and position which would be regarded by all as satisfactory, and concluded by thanking the giver of the toast for the kind expressions with which he had been greeted, and especially for the acceptance by the company of his invitation to inspect two inventions, one of which, the Hewitt mercury lamp, was, he said, a complete and accomplished thing. The other, the Hewitt static converter, was quite new, and he thought that it was likely, when fully perfected, to cause an immense stimulus in regard to the use of electricity in all parts of England, and particularly in the agricultural parts of the country, for farm work and for moving all kinds of vehicles.

BOOK REVIEWS.

"Electrical Engineers' Pocketbook." Horatio A. Foster. New York. The D. Van Nostrand Company. Morocco flexible back. 987 pages. 4½ by 7 inches. Numerous illustrations and tables. Supplied by the ELECTRICAL REVIEW at $5.00.

This is the third edition of this pocketbook which is now recognized as a valuable and authoritative compendium of useful data. The matter included is representative of American practice, and the book should find a place in every engineer's office.

"Successful Advertising; How to Accomplish It." J. Angus McDonald. Philadelphia. The Lincoln Publishing Company. Cloth. 400 pages. 6½ by 9½ inches. Supplied by the ELECTRICAL REVIEW at $2.00.

This is an important book for business men. There are a great number of advertising methods detailed, and the theme is treated in a clear, crisp and concise style which covers practically every phase of publicity. Advertising schemes, specimens of advertisements, points for the advertising student, writer, retail advertiser, the general advertiser and mail-order advertiser are carefully worked out. The book is broken up into five divisions, in the following order: Ad. building, retail advertising all the year round, special features in retail advertising, mail-order advertising and miscellaneous advertising. The book is handsomely printed on specially made antique paper, and the cloth cover is embellished with an artistic cover design. The busy man will appreciate the exhaustive index.

"The Art of Illumination." Dr. Louis Bell. New York. McGraw Publishing Company. Cloth. 345 pages. 6 by 9 inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $2.50.

This volume is a study of the utilization of artificial light. It is intended to deal not with the problem of distributing the illuminants, but with their application, and treats with the illuminants themselves only so far as a knowledge of their peculiarities is necessary to their intelligent use. The first part of the book discusses the general principles of lighting, effective color, reflection and diffusion, and the peculiarities of various types of illuminants now in use. Chapter viii deals with shades and reflectors and other means of improving the distribution of light. The chapters on domestic lighting and lighting large interiors, such as churches, theatres and factories, should be of great assistance to architects, while chapter xi, which deals with street and exterior illumination, should be equally valuable to those who have charge of municipal lighting. Chapter xii gives a study of decorative illumination; chapter xiii, the illumination of the future, and chapter xiv, standards of light.

"Hardening, Tempering, Annealing and Forging of Steel." Joseph V. Woodworth. New York. Norman W. Henley & Company. Cloth. 300 pages. 6¼ by 9¼ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $2.50.

This is a new work and treats of all modern processes for the heating, annealing, welding, hardening and tempering of steel. The author has prepared this work with the desire to supply as much information as possible in this field in a very small space. The treatment of the different subjects which, as the index shows, are very numerous, must necessarily be concise in order to be encompassed in a volume of this size. Half-tone and sectional drawings set forth the different processes and exhibit special forms of machines for performing this work. A valuable chapter of the book is that on tempering. This takes up in detail tempering by colors, in oil, on hot plates, by thermometer, in hot water, in the sand bath, and by special methods.

"Dies, Their Construction and Use for the Modern Working of Sheet Metals." Joseph V. Woodworth. New York. Norman W. Henley & Company. Cloth. 384 pages. 6¼ by 9¼ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $3.00.

This is a book for practical men, and is aimed to be a complete treatise on this subject. There are twelve chapters, which are subdivided into numerous sections. The chapters take up in turn the construction and use of "single" or blanking dies; simple dies for use in the machine shop; "gang" and "follow" dies —how to adapt and use them; the adaptation and use of simple dies and press fixtures for the economic production of sheet metal parts; bending and forming dies and fixtures; perforating dies and processes for thin and heavy stock; curling, wiring and seaming processes; drawing processes for sheet metal shells; coining processes—punches and presses for operation on heavy stock; the feeding of sheet metal to dies—lubrication of press work; annealing tool steel and hardening and tempering processes for press tools, including hints and suggestions on the proper use of files; miscellaneous dies, presses, fixtures, devices and special arrangements for sheet metal drawing.

"Steam Power Plants." Henry C. Meyer, Jr. New York. The McGraw Publishing Company. Cloth. 160 pages. Numerous illustrations. 16 plates. 6¼ by 9¼ inches. Supplied by the ELECTRICAL REVIEW at $2.00.

This book was written to give information to all who have to do with power plants, but more particularly those who are called upon to design and specify the various elements which are necessary and the proper combinations and arrangements for a successful plant. To this end each part is taken up in detail, studied alone and in relation to the installation as a whole, and specifications for its proper construction and erection are given. Chapter i takes up the general scheme for a power-house; chapters ii and iii consider the boilers; chapters iv and v the engines; chapters vi, vii and viii piping and other accessories; chapters ix and x mechanical draft and chimneys, and chapter xi coal and water supply. The book should be suggestive and valuable to all engineers, architects and students who desire information on the subject treated.

Cutting Angles of Tools for Metal Work as Affecting Speed and Feed.

At a recent meeting of the British Institution of Mechanical Engineers Mr. H. F. Donaldson submitted a paper giving the results of some experiments on the operation of machine tools. These experiments covered fourteen different qualities of material, including steel, wrought iron, cast iron and five yellow metal alloys of different degrees of hardness and chemical constitution. The angles of the cutting edges of the tools range from fifty-seven and one-half degrees to seventy-five degrees. The experiments were all made with pointed roughing tools. During the work, data were obtained with regard to the actual weight brought to bear upon the point of the tool when cutting. The results of the tests are given in tabular form, but the work is not yet considered complete. They show that when working with a high speed of material, a light cut and a fine feed, different angles are required to those found most suitable for heavier gear with slower speed of material and a coarser feed. The harder the metal, the more obtuse must be the angle of the tool.

A new telephone cable has been laid, connecting Elsinore, in Denmark, and Helsingborg, in Sweden, at the narrowest point of the sound. This will improve the telephonic connection between Copenhagen on the one side, and Gothenburg, Stockholm and Christiana on the other. The new cable is reported to be working admirably. It is intended to lay a new cable between the island of Lolland, Denmark, and the Island of Fehmern. This will be part of the line connecting the telephone systems of Denmark and Sweden with Berlin. It is intended to extend this system to Brussels and Paris.

Fire at the Niagara Falls Power Company's Plant.

An unlooked for incident in the history of the Niagara power development occurred on the night of Thursday, January 29, when lightning caused short-circuits and started a fire on the bridge over the inlet canal connecting power-house No. 1 with the transformer station. It was 10.45 P. M. when the fire started, and at the time approximately 50,000 horse-power was being sent over the fifty-two 1,000,000 circular mils cables that ran through the bridge from the power-house to the transformer station. The fire made surprising headway. The generators in the power stations were shut down and all load thrown off. Employés of the power company fought the fire and were aided by the city fire department, which was quickly on the scene in response to an alarm. The flames ran along the bridge interior and secured a hold in the transformer station. The bridge is a stone structure with slate roof, and the transformer station is also of stone construction, but both were badly damaged. The fifty-two cables were destroyed, severing all cable connection between power-house No. 1 and the transformer station. For the time being this made it impossible for power to be transmitted to Buffalo, Lockport or to the Tonawandas, while it also interrupted the service of the manufacturing plants on the lands of the power company that had been receiving power over the cables on the bridge. This robbed Buffalo of its main source of street lighting, of power for the operation of the electric lines in the city and to Niagara Falls and Lockport, and of power for the operation of numerous industrial establishments that were run by power from Niagara. In Lockport there was similar trouble, so far as its trolleys and several factories were concerned, and in the Tonawandas there was the same story. In Niagara Falls the trolley cars were stopped for a time during and immediately after the fire, and the street lights were out. So far as its electric cars and street lights were concerned, Niagara Falls fared better than other places using Niagara power, for it was soon possible to renew these services, and the stoppage was brief.

Despite the extent and nature of the trouble, the Niagara Falls Power Company was prepared for it. As soon as the fire had been put out the company's forces were marshaled under the direction of Superintendent Barton, and the work of making repairs immediately begun. For the remainder of the night there was surprising activity. In order to meet just such unfortunate occurrences, the Niagara Falls Power Company keeps in reserve a large amount of cable and parts of machines liable to be damaged by accident. This has always been a rule with the company, and the wisdom of it was manifest at the time of the fire. There was no long wait for missing parts or necessary cable. Everything was at hand, and with this knowledge Superintendent Barton labored hard so that he might be able to furnish Buffalo power by noon Friday.

In order to extinguish the fire in the transformer station the firemen had found it necessary to throw many tons of water into the building. This wet some of the transformers and later caused delay. All cable connections had been made to give power to Buffalo, when water in a transformer caused a postponement of the service until 4.30 o'clock Friday afternoon, but at that hour, about eighteen hours after the fire, 10,000 horse-power was being sent from Niagara to Buffalo. And this was not the result of good luck, but the result of the preparation made by the power company to overcome trouble when it occurred. All of the organization of the company tends to this end, and the company was pleased that when its resources were tested it was not found wanting. The work of connecting up went rapidly forward. Buffalo was on Friday night in receipt of its usual amount of power. Some of the tenants of the Niagara Falls Power Company resumed operation of their plants Friday night, but it should be mentioned that the Niagara factories that receive power from station No. 2, the cables from which did not cross the injured bridge, were only briefly interrupted. By Saturday afternoon all but one of the Niagara plants were in operation, and outside places were getting power as usual.

Those who know how generally Niagara power has been applied in and about Niagara Falls, Buffalo, Lockport and other places can easily conceive that the effects of the trouble at Niagara were far-reaching. Fortunately, the hour was pretty late, and the lack of light in Buffalo was not felt so much as it would have been two or three hours earlier. The trolley cars stopped with the shutting off of the current, but the International Railway Company threw in its storage battery and then its steam plant to operate its cars, the number of which was necessarily reduced until the Niagara service was resumed Friday afternoon. All of the Buffalo plants using Niagara power were unable to run. In some cases the men had a holiday, while in others they were kept ready to go to work should the power come on. In Lockport and the Tonawandas the users of Niagara power had a similar experience.

Niagara has not yet recovered from its surprise of having an electrical storm in January.

The Annual Dinner of the American Institute of Electrical Engineers.

Arrangements for the annual dinner of the American Institute of Electrical Engineers at Sherry's on Monday, February 9, are being pushed rapidly, and there is every prospect of a great success. The speakers will include Mr. Andrew Carnegie, on "Libraries;" Dr. S. S. Wheeler, on "The Latimer Clark Collection;" Dr. J. S. Billings, director of the New York Library, on "The Technical Library;" Mr. R. R. Bowker, editor of the *Publishers' Weekly*, on "The Unity of Science;" Theodore L. De Vinne, the bibliophile and great American printer, on "The Debt of Mechanics to Science," and Dr. J. C. Bayles, technical editor of the *New York Times*, on "Electricity and the Daily Press."

The menu cover prepared is a fac-simile in three colors of one of the larger volumes, dated 1494, presented by Dr. Wheeler, in the Latimer Clark collection, and shows the volume as it now stands in the Institute Library, label and all. Two of the annotated pages are also reproduced. Tickets will be $5 each, orders for which should be sent in at once to R. W. Pope, 95 Liberty street, New York city.

The Independent Telephone Association of Wisconsin.

The Independent Telephone Association of Wisconsin will hold its annual convention in Milwaukee, Wis., on February 11 and 12. This meeting will be of unusual importance in many ways, and indications give promise of a well-attended and successful session. A large number of prominent telephone men in Wisconsin and neighboring states will take part in the programme and it is expected that the papers and discussions will be of great practical interest and value.

Nearly all of the prominent telephone manufacturers and supply houses of the Northwest will make exhibits at this meeting.

The headquarters of the association will be at the Hotel Pfister, and the sessions will be held in the hotel convention hall.

AUTOMATIC ELECTRICALLY CONTROLLED ENGINES.

BY GEORGE E. WALSH.

The fallibility of engineers to make fatal errors at critical moments in running express trains is emphasized occasionally by serious railroad disasters, and each time there is a widespread agitation for some reforms in block-signal systems or other methods of controlling the trains.

It is to reduce the whole machinery of train control to an automatic basis as far as possible that has induced inventors and electricians to experiment extensively in recent years with block signals, brakes, and other devices for train control.

The best air-brakes have many times proved of little avail because of the fact that they have not been applied in time, and the most perfect electric block signals have proved futile simply because their warning has been unheeded. There have been two electric automatic train-controlling systems perfected which would seem to make up for any of the deficiencies of the human intellect guiding the engine. The first of these systems is more elaborate, and somewhat complicated in its instalment, but it is one that many railroad officials consider with increasing favor. This is nothing else than to equip the line with an electric control system which enables the operator or train despatcher at headquarters to apply the brake on any engine running on the line. It is proposed to have in the main office of the railroad a perfect model of the tracks of the whole system over which small miniature trains are running simultaneously with those on the regular tracks. These models are in electrical touch with the moving trains. When the latter stops the model engines do the same. As the model track is exactly the same as the large one, but on a very small scale, it is possible for the train despatcher to see when any two trains are approaching on the same track. Small duplicates of the block signals are operated on the model, and when an engineer runs past a danger signal set against him, the operator at headquarters knows it. The whole control of the trains is made simple by this electrical connection. The operator can by disconnecting the switch attached to his small model engine apply an electrical brake to the engine corresponding to the model. In other words, the control of any engine can be taken immediately from the hands of the engineer. Moreover the electric brake applied in this way at headquarters can not be released by the engineer.

Such a system is somewhat elaborate in its methods, but it enables the man at headquarters to check off the engineers all over the different lines of track. He has his eyes on each one, and notes the observance of the different signals by the engineers. No accident on the road could happen without a similar collision occurring between two of the model trains. The approach of any two of these on the same track would immediately attract the attention of the operator, and he would be prepared at a moment's notice to stop either or both by touching a button.

A method of supplying the engineer with red and green or white lights in his cab to warn him of danger is likewise based upon the electrical system; but this has the fatal disadvantage of failing to eliminate the human element. The engineer may prove in an emergency as forgetful of his danger lights in his cab as those flashing to him from the semaphores. This system would of course eliminate the danger due to obscuring signal lights by thick clouds of smoke from the engine. Sometimes the steam from the locomotive is so dense that a red or white light might temporarily be shut from view, and the engineer taking it for granted that no danger signals were set against him might continue his course.

Such a system would require complete electrical installation of the road in sections, and if this is to be done an improved train control service could be had by adopting the modern device for shutting off steam and applying the brakes automatically. This system has the advantage of working absolutely automatically, and the engineer and train despatcher are both removed from the problem. They have no control over the train when it once enters a section where there is any danger either from collision with another train or from a broken track, misplaced switch, or broken bridge. The whole railroad system is automatically controlled by electric devices which seem to assure absolute safety to passengers.

The electrical device for this method of train control is a simple and ingenious instrument which is installed in the cab of the engine, occupying comparatively little space, and being so inconspicuously attached to the throttle and air-brake apparatus that it would hardly be noticed. It can be operated so as to display white, red or green lights in the cab to show to the engineer that all was safe ahead. But this little monitor's service does not end there. It is ready at a moment's notice to act. Almost simultaneously with its display of a danger light it closes the throttle and applies the air-brake so that the train would come to an instant halt.

The track system is divided into sections of any desired length, and electrical connections made to operate the little safety device in the cab. In each block the rails of the track are electrically connected; but while the right track has a continuous connection the left is broken at the end of each block. Where the electrical connection ends at the terminus of a block on the left rail there is a device arranged in the shape of a short rail. This small rail is electrically connected with the left rail of the section immediately ahead by a wire. When the engine comes along and enters the new block a contact lever underneath touches this short rail. If the section ahead is short-circuited by the trucks and wheels of another train or engine this fact is immediately communicated to the oncoming engine by means of the contact rail touching the lever.

When entering a new block the short rail connected by wire with the left rail ahead must show to the engineer that it is not short-circuited, or the current broken by a deranged or broken rail. If the flow of the current is interrupted by any accident ahead or by a train being on the block, it immediately closes the throttle and applies the air-brake. The device for doing this will be understood very easily. A wire runs from the truck of the engine up to an electromagnet in the cab, and thence back through a resistance coil to a contact arrangement which holds the lever designed to touch each short rail at the beginning of a new block. The current flows through this course at all times except when the short contact rail is touched to announce the beginning of a new block. The current is then broken, and if the track is clear ahead in the entire block it flows through the entire left track to the end of the section and back through the right rail to the truck, and from thence up to the electromagnet in the cab. This complete change of the current occurs at the beginning of every block of the road.

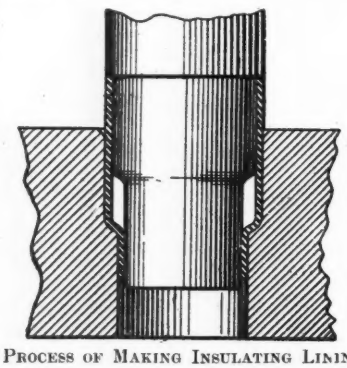
If there is a train on the block ahead this ordinary flow and regular interruption of the current are changed, and a second magnet in the cab is affected. This second one is connected in parallel with the first, and is provided with an armature which serves as a switch for the battery. When a train ahead short-circuits the current, the resistance is sufficient to make the second armature overcome the spring which holds it back from its magnet. The closing of the circuit would immediately follow, and this would close the throttle and apply the brake. Thus immediately upon entering the new block, before the pilot wheels had barely touched the rails, the brake would be applied and the steam cut off.

Likewise if the rails ahead were broken or twisted out of shape so that the electrical connection was broken, or if a bridge was damaged so the rails were parted, the same application of brakes and shutting off of steam would follow. In fact, any interruption of the regular flow of the current, and its periodical change when a new block is entered, would cause the second electromagnet to become so energized that it would immediately attract its armature. When this is accomplished, a lever and link connection with the throttle and air-brake would produce the desired results.

The only possible trouble with such a system would come from the derangement of the wires or mechanism of the device. This, however, would not occur often if the installation was perfect and the engineer would be apprised of the fact by unmistakable warnings. One of these would be the failure of the electric light in the cab to burn; another the automatic ringing of a bell. In fact it is comparatively easy to modify the system so that any kind of warning could be given to inform the engineer that the apparatus was not in working condition.

Electrical Patents.

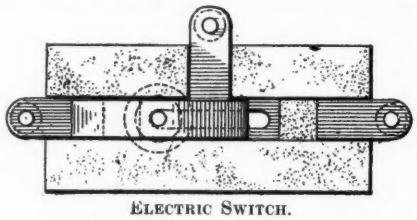
The General Electric Company controls a patent recently issued to Mr. Geo. G. Painter, of Schenectady, N. Y., on an insulating lining and process of making the same. The invention relates to that class of electrical apparatus in which a metallic shell surrounds other metallic parts, serving to carry or regulate an electric current, as for instance, incandescent lamps, though useful in various other relations. In such apparatus, it is highly desirable that the metallic shell should be lined with an insulating sheet, and it has hitherto been the custom to stamp out from sheets of fibre or similar material, curved pieces which would when assembled form an approximately cylindrical lining of the proper shape. This arrangement was objectionable, however, partly because of the cost of manufacturing and assembling such pieces and partly because of the imperfection of the lining thus formed. The present invention contemplates forming a single lining of the proper shape made in one piece and entirely suitable for the purpose intended. For this purpose, tubes of insulating material which may be either fibre, hard rubber or the like, are cut into suitable lengths and submitted to the action of dies. The female die, which constitutes a part of the operating table, has a socket formed by a bore and



PROCESS OF MAKING INSULATING LINING.

a concentric counterbore, this counterbore having a working fit with the tube section. The male die is constructed so that its upper portion will fit snugly within the upper end of the tube section and is provided with a shoulder, against which the end of the tube section abuts. The lower end of this die is reduced sufficiently to fit within the reduced bore of the female die. In forming the linings, the tube sections are first placed upon the male die which is then reciprocated by a suitable power press and moves downwardly into the female die. As a result, the lower end of the tube section is compressed to exactly the desired form and can not become buckled or distorted. Afterward, the necessary notches through which the securing screws and socket keys pass are cut in any desired manner, usually by a milling cutter.

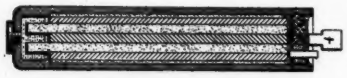
Mr. William R. Thompson, a resident of Norwalk, Ct., has patented an electric switch and has assigned a one-half interest in this patent to Mr. George N. McKibben, of the same place. A rectangular base-plate is employed which is formed of insulating material and has



ELECTRIC SWITCH.

a longitudinal recess or channel in its under face, a transverse channel being also arranged in the under face and extending to the longitudinal channel. A longitudinally disposed slot extends through the base-plate to the longitudinal channel. In the ends of the longitudinal channel and the transverse channel are secured contact terminals which project beyond the base and are provided with binding screws to which the wires can be attached. Slidably mounted in the slot is a stem carrying at its outer end a thumb-piece and being attached at its inner end to a bowed switch spring that is thus movable in the longitudinal channel, so that one end may be moved into contact with the adjacent terminal, while the other end will engage the intermediate terminal. The current can thus be switched by simply moving the stem or thumb-piece in the slot. The inventor claims that the device is particularly useful in connection with the sparking mechanism of an explosive engine, where it is desirable to start the engine by connecting the mechanism with a battery and then switching it into circuit with a dynamo.

Mr. Miller R. Hutchinson, of Upper Montclair, N. J., has patented an electric battery and the Hutchinson Acoustic Company has acquired control of the same. This invention related to electrical batteries, both primary and secondary, and has special reference to what are known as the "dry" or "semi-dry" class of battery. One of the objections to this class of battery is that such liquid material as is provided in the sealed cell dries out in a comparatively short time and renders the battery useless. Such batteries have therefore been provided with means for renewing or supplying the liquid material either in the form of plain water or acidulated water. The improved cell relates to this latter class, inasmuch as it is provided with means for replenishing the liquid whenever desired. Such a cell is also necessarily provided with a vent opening to carry off the gases generated while the battery is in action, and it is through this vent that most of the moisture passes out. The vent is usually located in the top of the cell, at which point also it has been customary to provide the opening through which to replenish the liquid material. To render the battery dry or semi-dry, it is customary to use a suitable porous material, which is filled into the spaces not occupied by the electrodes, a small free space being left above the electrodes and immediately beneath the sealed cover of the cell to receive the liquid poured through the opening in the top. The liquid material is poured in slowly to allow time for it to be absorbed by the porous material, and finally the space at the top is filled and the cell again sealed. Now it has been found in practice that when a battery thus replenished is put into use the generated gases force the free liquid out through the vent opening in bubbles, and if the battery is used under conditions where this is undesirable—such, for instance, as when it is carried upon the person—this escape or leakage is very ob-

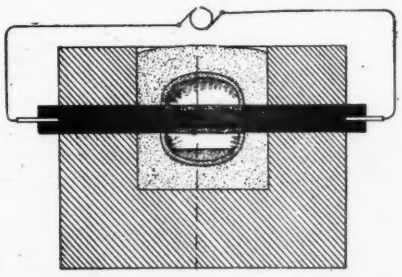


ELECTRIC BATTERY.

jectionable, besides wasting the liquid in the cell. Another disadvantageous feature of replenishing the liquid in the cell in the manner above described is the fact that it interferes with the action of the battery. The gases which are formed at the surfaces of the plates in the cell should be allowed a free and uninterrupted escape through the vent; but when the upper part of the cell is filled with free liquid and the liquid is constantly working downward to fill the dry places in the absorbent material it obstructs the upward movement and escape of the gases, which defect it is, of course, desirable to cure, and this, together with the other defect above mentioned, is the object of this invention. In the improved cell the inventor provides the free space or reservoir for the liquid in the bottom or side and fills the reservoir through an opening suitably located in the cell. The vent opening is separated from the reservoir by the porous material in the cell. In this manner the gases traveling toward

the vent opening do not encounter free liquid, and consequently can not force free liquid out through the vent, nor do the bases encounter liquid flowing or percolating through the absorbent material in a direction contrary to its movement, but instead such liquid moves in either the same direction as the gases or in such a direction as not to retard their progress. It is also desirable to have a liquid reservoir of considerable capacity in the cell, for the reason that in the charging operation the liquid held by the absorbent is decomposed to release hydrogen, and in discharging there is a tendency also to decrease the degree of saturation, which losses should be at once replaced by liquid from the reservoir to prevent increasing the internal resistance of the cell.

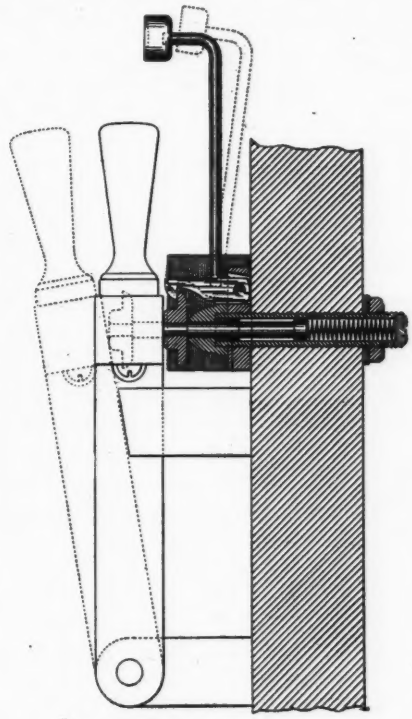
An electric furnace that is considered to have peculiar advantages for certain purposes has been patented by Mr. Edward G. Acheson, of Niagara Falls, N. Y. The invention relates to an electric furnace so constructed that the materials to be treated therein may be subjected to heat without any disturbing chemical influence being exerted upon them by the conductor through which the current passes and in which the heat is generated. Such conductors are usually made of carbon, and the affinity of carbon for other elements has hitherto served to prevent the use of electric furnaces for the performance of many reactions for which it otherwise would be well adapted. In constructing the new furnace, the inventor takes a conductor, preferably of carbon, and places between it and the material to be treated, a protecting layer or



ELECTRIC FURNACE.

sheath composed of a refractory carbide, which is preferably formed and placed around the conductor, or it may be created in the furnace at the outset of the process. Having thus protected the conductor from contact with the material to be treated, he raises the conductor to a high temperature by the passage of an electric current and heats the material to be treated by conduction or radiation therefrom. The material to be treated may consist of a mixture of metallic oxide or compound with a reducing agent, preferably carbon, and being shielded from the core is not affected thereby to any injurious extent, or the furnace may be used simply for melting materials such as silica or other compounds or metals. The material to be heated is necessarily different in ingredients or proportions from the protecting layer of carbide.

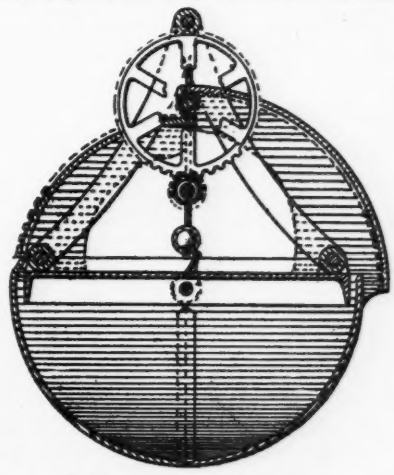
A new quick-break electric switch has been devised by Mr. Frederick A. La Roche, of New York city. The switch



QUICK-BREAK SWITCH.

itself may be of the usual form, and, indeed, the invention is capable of being applied to those now generally in use. In the base is mounted a threaded tube secured by suitable nuts and located directly beneath the free end of the switch blade. In this tube is slidably mounted a plunger, normally forced outward by a coiled spring also arranged in the tube behind the inner end of the plunger. The outer end of this plunger carries a head that bears against the free end of the switch and the head has a peripheral outstanding flange engaged by a pivoted latch secured to one of the holding nuts of the tube, the latch being arranged to hold the plunger in its innermost position so as to permit the switch being closed without interference. An upstanding lever arm is secured to the latch and is provided with a knob or head at its upper end. As long as the plunger is locked in its innermost position, the switch may be used in the ordinary manner, but if a quick break is desired it is only necessary to press the lever inwardly, thereby disengaging the latch from the head of the plunger. The plunger will be immediately pressed outwardly thereby swinging the switch to its open position.

A dredge operated entirely by electric motors has been patented by Mr. Ephraiem Chaquette, of New Rochelle, N. Y. The invention relates particularly to that class known as clam dredges. The usual boat or float is employed, and upon the same is built a suitable frame. At one end of this frame is pivoted a horizontally swinging carrier arm, the free end of which is supported upon a track located upon the frame. A motor mounted upon the carrier arm is provided with a pinion that meshes with a rack secured to the frame, and as a result the arm can be swung through a lateral space of about fifty feet, or from side to side of the dredge float if but one arm is employed. The inventor, however, preferably provides two which are entirely separate from each other and are independently operated. Upon the free end of the carrier arm and projecting beyond the end of the float is a clam frame from which is suspended a discharge funnel or chute that conducts the material from the clam to a receiving scow. The clam is supported by ropes running over pulleys, one of which is journaled upon the clam frame, the other being arranged at the pivoted end of the carrier arm where suitable counterbalances are provided. The ropes or cables are operated by a suitable motor having sufficient power to raise the clam when filled. The clam, as usual, is constructed of two sections pivoted together and having upstanding arms provided with racks. The sections are supported on a triangular frame which constitutes a support for an electric motor having gears meshing with the racks, this



MOTOR-DRIVEN DREDGE.

motor thus serving to open and close the clam and being movable therewith. A novel arrangement of electrical connections and switches is used in connection with this motor, so that when the clam is submerged in its open position, current is automatically supplied to the motor which is thereby operated, consequently closing the clam. The clam is then elevated, and when it reaches its highest position the motor is again automatically operated to open it, so that the contents are discharged into the chute.

Reviews of Current Engineering and Scientific Literature.

Electrical Transmission of Vision.

In this article, Lieutenant J. H. Coblyn reviews briefly the theoretical aspect of transmitting vision electrically, and the attempts which have been made at its practical solution. The selenium cells usually used in investigations of this kind are too sluggish, and it is probable that before satisfactory results can be obtained a better transmitter must be developed. The author suggests the use of a Blondel oscillograph as a receiver, the moving part consisting of a tube which as it is deflected cuts of more or less the light from a source of constant intensity. This method is a modification of that devised by Ayrton and Perry. Another method, which was suggested by M. Weyler, was to use a sensitive flame, the intensitv of which is varied by a telephone diaphragm actuated by the transmitted current. In addition to the problem of reproducing the intensity of illumination, much difficulty is to be expected in securing synchronous operation of the transmitting and receiving devices, as the whole surface must be covered in less than one-tenth of a second, the time of duration of the retinal impression. The author concludes that the problem is surrounded with great difficulties.—*Abstracted from Nature (London), January* 15.

Temperature Changes in a Magnetic Field.

Herr E. Aschkinass has carried out some further researches on the effect noticed by Nernst and others of a magnetic field upon hot bodies. In Nernst's experiment, a copper rod heated at one end was placed between the poles of a vertical electromagnet. It was found that whenever the electromagnet was excited that the temperature of the air above and below the rod fell. The reduction in temperature was sufficient to be measured by a mercury thermometer. As Nernst did not detect any change of temperature except in the plane of the rod, it did not appear that the action could be caused by a change in the permeability of the air surrounding the hot rod. The author, however, has carried out some very careful experiments with the magnet in a horizontal position. He found that the temperature change took place at any point within the magnetic field. Assuming this to be due to the change of the permeability of the air when heating, the experiments were extended to other gases. The same effect was found for oxygen, but heated oxygen was also found to be more magnetic than cool air. The effect was not noticeable with nitrogen or carbon dioxide. Reference is made to Faraday's work in which a current of air was passed through a heated tube and directed between the poles of an electromagnet. The effect of the latter in reducing the temperature between its poles when excited is entirely analogous to the experiments described above.—*Translated and abstracted from Physikalische Zeitschrift (Goettingen), January* 1.

Electrolytic Preparation of Antimony.

The electrolytic extraction of antimony from its minerals is becoming very important because of the wide use of this metal in preparing anti-friction alloys and lead alloys for accumulators. The problem has received the attention of a number of investigators, whose methods are here described by M. J. Izart. Notable among these are Borchers and Engelhardt. The latter, working for the Siemens & Halske Company, developed a process, but abandoned it on account of the high cost of the electrolyte, sulphide of sodium. Antimony occurs generally as stibnite or sulphide of antimony, and the problem is to secure the metal in a pure condition and to prevent loss of the reagents. The electric furnace can not be used, since it does not give a pure product. This leaves only wet processes. In these processes salts of organic acids can not be used because the acids are decomposed by the action, giving off carbon dioxide, which has no commercial value. The common salts of chlorine, bromine and iodine can not be used because of the difficulty of handling the products. Moreover, the deposit from these salts is amorphous, sometimes brilliant, sometimes gray, and possesses the property of exploding from shocks or heat. Solutions of sulphides, on the contrary, give very brilliant, silver white granular or fibrous deposits, which are very adherent. If alkaline solutions are used, electrolysis gives rise to poly-sulphides, which, diffusing to the cathode, redissolve the deposit. Siemens & Halske dissolve the mineral in an acid sulphide of sodium. The electrolyzing vats are fitted with diaphragms. Sulphureted hydrogen is given off and is lost. Sodium chloride is added to the anode compartment. By this method coherent plates of antimony having a purity of 99.69 per cent have been obtained, but as the sulphur is lost the method is not complete. The author's process consists in treating the mineral with a solution of sulphide of sodium. This is electrolyzed in a vat having a diaphragm, and a seventeen per cent solution of soda is introduced into the anode compartment. The cathode receives a good deposit of antimony, while the sulphide of sodium is regenerated in the anode compartment. The process has been tried on a small scale, the generator used having a capacity of three kilowatts. The output was 0.55 kilogramme of antimony per kilowatt-hour. By reducing the current density, the output has been raised to 0.621 kilogramme per kilowatt-hour. By this method poor minerals can be treated profitably.—*Translated and abstracted from L'Industrie Electrique (Paris), January* 10.

Test of Engine with Superheated Steam.

Professor J. A. Ewing has made a series of tests upon a horizontal, tandem, two-cylinder, compound engine, using superheated steam. The tests were made for Easton & Company, the builders of the engine. This is one of a pair, each indicating 300 horse-power, and used to drive a three-phase generator. Each engine is fitted with a Schmidt reheater in the receiver between the two cylinders. This reheater acts by transferring a portion of the superheat of the highly superheated live steam to the steam which has done duty in the high-pressure cylinder. Steam is supplied from a Lancashire boiler at 140 pounds pressure, and is superheated in an independently fired Schmidt superheater to nearly 800 degrees Fahrenheit. It reaches the engine at a temperature of about 750 degrees Fahrenheit, but gives up about 170 degrees Fahrenheit of this superheat to the steam in the receiver. The engine has Corliss valves, and is fitted with a jet condenser with a vertical air pump driven by means of a bell crank lever. The mechanical power was determined by means of four indicators, from which cards were taken every quarter of an hour. The consumption of steam was found by measuring the feed water. Four trials were made, enabling curves to be drawn showing the consumption of steam per hour under all loads. The results are

as follows: With an indicated horse-power of 175, the electrical output was 97 kilowatts. The consumption of steam was 9½ pounds per indicated horse-power-hour, or 17.2 pounds per kilowatt-hour. At 239 indicated horse-power the electrical output was 143 kilowatts, and the consumption of steam was 9 pounds per horse-power-hour, or 15 pounds per kilowatt-hour. At an indicated horse-power of 312, the electrical output was 190 kilowatts, and the consumption of steam 9.4 pounds per indicated horse-power-hour, and 15.4 pounds per kilowatt-hour. The results show that the engine preserves a high level of efficiency throughout the whole range, from full load to half load. The weights of coal burned show that for each pound of coal put in the boiler fires 8.7 pounds of steam were evaporated at a pressure of 140 pounds, and from feed water at 75 degrees Fahrenheit. Also, for each pound of small coal put on the superheater fire, 241 pounds of steam were superheated to 800 degrees Fahrenheit. The total quantity of coal used in giving heat to one pound of engine steam was 0.157 pound. —*Abstracted from Mechanical Engineer (London), January* 17.

Behavior of Rotary Converters in Traction Installation with Stationary Accumulators.

In this article Dr. Angelo Banti describes the action of a synchronous converter which is used for charging the accumulator for the Anglo-Roman Traction Company, of Rome. The machine which was constructed by Ganz & Company is single-phase with split-pole pieces, the poles being built up of distorted U-shaped sheets of soft iron. In testing this converter, it was noticed that for apparently the same output the input varied according to the character of the work performed by the machine. The input was greater when charging accumulators than when furnishing current to a non-inductive resistance. The cause of this could be attributed to two effects—either the phase of the alternating current fed into the converter varied with the character of the load, or the volt-amperes of the direct-current side were not equal to the true watts. This latter condition might arise if the continuous current were not constant, but fluctuated. To test for this, the machine was operated on loads of both character and measurements taken of the current, pressure and watts, both input and output. It was found from these readings that the power-factor of the alternating side was quite high and fairly constant, but the power-factor of the direct-current side was lower than that of the alternating side and varied with the kind of load. In charging the accumulators, the direct-current power-factor was about eighty-six, while the power-factor of the alternating side was varied from ninety-five to ninety-eight. To detect fluctuations in the continuous current, the secondary of a transformer was connected in series in the continuous-current circuit and measurements made on the primary. When charging the accumulators, a current of several amperes could be drawn from the transformer, but no effect was noticeable when the load consisted of non-inductive resistance. Finally, the form of the direct current was traced by a special instrument and was found to have a decided wavy form when charging the accumulators. It was found that by introducing a suitable inductive resistance in the alternating-current side, the power-factor of the direct-current side could be brought up to unity. —*Abstracted from Electrician (London), January* 16.

Magnetostriction in Bismuth.

In this article Mr. E. Van Aubel examines the evidence for and against a change in length of a bar of bismuth when placed in a magnetic field. This effect has been sought for by many physicists. Sherford Bidwell in 1888 noticed a very appreciable increase with a magnetic field of 470 C. G. S. units. Tyndall was probably the first to examine the question, but he found no variation in length. More recently, Mr. A. P. Wills has searched for this effect, as well as the author. The latter in 1892 examined the influence of magnetization upon the length of a bar of bismuth, using Fizeau's method of interference fringes and a bar of bismuth thirty-one centimetres long. This was made of the absolutely pure metal that can be used by Classen for the determination of the atomic weight. No elongation could be found. Bidwell repeated his former work, using another sample of bismuth, and failed to detect any change in length. He therefore says that little importance should be attached to any such observations unless the bismuth employed has been proved by analysis to be free from traces of magnetizable metals. Dr. C. G. Knott has observed a change of length, but the effects were very weak and doubtful, and he considers that his material was impure. The evidence seems to show that all experiments made up to this time establish the fact that a bar of pure bismuth does not change length in a magnetic field.—*Abstracted from Physical Review (New York), January.*

Bournemouth Corporation Electric Tramways Undertaking.

This is the first of a series of articles describing this system of railways which was put in operation the middle of last December. In this section the power plant is described. The buildings, including the generating station and car sheds, are conveniently situated on the London & Southwestern Railway from which a private siding is taken for the purpose of coaling. The station is about midway between the two termini of the tramway system. The engine room is 119 feet long by 35 feet 6 inches wide and has a height of 23 feet to the level of the traveling train. The boiler house is 89 feet by 65 feet with spacious bunkers for coal storage. The boiler room contains four Lancashire boilers 30 feet by 8 feet 6 inches in diameter. These are fitted with mechanical stokers, ash conveyors, superheaters and economizers. The engine room contains at present four direct-connected engines. These were built by Belliss and Morcom, and are of the three-crank, triple-expansion type with cylinders 12 inches, 18½ inches and 28 inches in diameter by 12 inches stroke. They are throttle governing, a by-pass being provided which admits live steam into the intermediate cylinders when the throttle valve is full open and the speed still below the normal, to deal with overloads. The generators were supplied by the British Thomson-Houston Company. They are the railway type, each having eight poles and capable of giving 292 kilowatts at 550 volts and running 360 revolutions per minute. The fields are compound wound to give a constant pressure at all loads. The engines exhaust into two surface condensers. The cooling water is circulated by means of centrifugal pumps to the top of a cooling tower capable of dealing with 100,000 gallons of water per hour and reducing the temperature to eighty degrees Fahrenheit. The main switchboard consists of six dynamo panels, seven feeder panels, a motor-generator panel and a meter panel. This was furnished by J. G. Stetter & Company, and by their special instruction avoids the use of all irons at the back of the board. The article is well illustrated and contains complete piping diagrams.—*Abstracted from the Electrical Engineer (London), January* 16.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Multipolar Motors and Generators.

In the accompanying illustrations are shown a few of the parts and also some assembled mechanism of small machines for general power purposes. These range in size from one-eighth horse-power to two horse-power, inclusive, in motors; and in generators from one-tenth kilowatt to one and one-half kilowatts, inclusive.

In designing these machines, a radical departure has probably been made in constructing them of a multipolar instead of the usual bipolar arrangement for machines of this capacity. The armatures, also, are of form-wound coil, ventilated type, similar to those used in machines of larger size. The result of these departures, the manufacturer claims, has been the securing of higher efficiency, perfect working and very general success of machine operation.

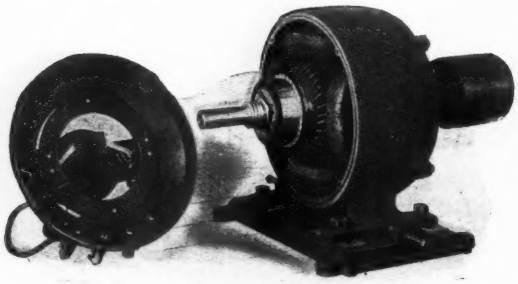


FIG. 1.—ASSEMBLED MACHINE.

The field frame is cast in one piece, including the split poles. A special grade of dynamo cast steel is used, which ensures a high magnetic permeability. The pole-pieces, being solid with the frame ring, are machined at one operation and are consequently of uniform accuracy.

FIG. 2.—ARMATURE.

The field coils are form wound, highly insulated and water-proofed. The core of the armature is built of soft charcoal steel, each disc being punched at a single stroke. The discs are compressed on the shaft in a hydraulic press and secured by heavy end-plates. The method of die-cutting the discs makes unnecessary any filing after assembling on the armature shaft.

The commutators are made of fine grade Lake Superior copper, cold rolled. Amber mica is used for insulation between the segments and between them and the supporting spider. The assembled commutator is securely and rigidly locked together, so that the development of high or low bars is entirely obviated. Sparkless commutation is effected by the use of a large number of segments.

The brush-holders have been especially designed both for mechanical and electrical perfection, and also with a view to æsthetic conditions. The design permits of convenient adjustment and renewal of carbons. The brush-holder rim is so secured to the commutator rim that the brushes always maintain a proper position.

Fig. 1 shows a complete machine with a commutator end bonnet taken off in order to expose the arrangement of the field coils, ventilated, form-wound armature, commutator, brush-holders, carbons and binding-posts. Fig. 2 shows the armature. These machines are designated as the "Watson" multipolar motors and generators, and are built by the Mechanical Appliance Company, Milwaukee, Wis., exclusively for the Northern Electrical Manufacturing Company, of Milwaukee, Wis.

New Steam Turbine Installation.

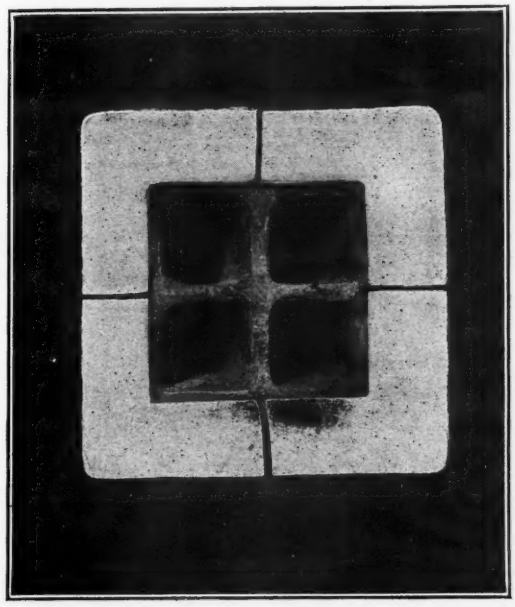
An interesting example of the application of the steam turbine to power generation from small central stations is afforded by the installation recently contracted for by the Rockland Light and Power Company, of Nyack, N. Y. This company has for a number of years been engaged in furnishing light and power to the local territory surrounding the town of Orangeburgh, N. Y., where the generating station is located. The electrical supply system covers a territory of considerable extent, embracing the towns of Nyack, Grand View, Piermont, Sparkhill, Tappan, Orangeburgh, Blauvelt, Nanuet, Spring Valley and Monsey. The territory will be covered by five independent distributing systems, each fed by a separate transmission circuit from the power-house at Orangeburgh. The load consists mainly of incandescent lighting, but motors of considerable capacity are installed at a number of points. The present equipment of the station comprises a number of different types of boilers, engine and generators. The latter are belted outfits, and will be largely replaced by the new steam turbo-generator unit to be installed. The present system is a two-phase, 3,300-volt alternating-current system, each generator operating independently upon a separate circuit. In the new arrangement, provision has been made for operating the entire system from the turbo-generator unit, the remaining machinery being held in reserve for periods of heavy load. The turbine is of the standard single-cylinder, multiple-expansion type, built by the Westinghouse Machine Company, of Pittsburg, Pa., and is of the same type that has been so successfully installed in other power works, notably the Westinghouse Air Brake Company, Hartford Electric Light Company and the Yale & Towne Manufacturing Company, of Stamford, Ct. The turbine will be furnished with superheated steam at 125 pounds' pressure, this being accomplished by an independent superheater with which a superheat of 100 degrees to 125 degrees Fahrenheit will be obtainable. The mechanical equipment includes also a Snow condenser, capable of maintaining a high vacuum, an Alberger cooling tower for cooling the circulating water, and a mechanical draft outfit. The turbo-generator will be of the type recently standardized by the Westinghouse Electric and Manufacturing Company for this class of service, and will furnish two-phase, sixty-cycle current at 3,300 volts directly to the station bus, from which the several transmission circuits extend in various directions to the local centres of distribution.

The Gest Adjustable Conduit Terminals.

The great demand which has been made by all municipalities for underground systems for the conveying of electrical transmission circuits had led conduit manufacturers to increase the utility and appearance of this method of construction. One of the most practical improvements which has been adopted in this line is the adjustable terminals manufactured by G. M. Gest, Cincinnati and New York, for ending up in a finished manner any form of conduit system. As

may be seen from the accompanying illustration, these are so arranged that at the end of the conduit line there may be left no broken or roughened edges which might injure the cables by abrasion or continued contact.

The terminals are made of cast iron, with white enamel surface, and also of glass, porcelain or vitrified clay. The end pieces are made with a ninety degree angle, and are fitted with a flange deep enough to allow the conduit ends to butt up firmly. Filler pieces are also made, so that no matter what the depth or length across the face of the conduit system may be, these being of standard sizes,



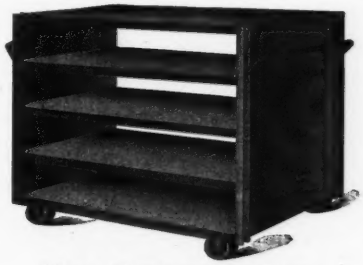
THE CONDUIT TERMINALS IN PLACE IN MANHOLE.

a combination of corner pieces and fillers will accommodate any form of construction. In addition to the internal flange against which the conduit head is fitted, the outside of the terminal is flare-shaped so that a deep bedding of cement can be laid upon it, bringing the brick course up flush with the face of the terminal. The terminals are made of ample size to withstand very severe usage, and have been put down and are in very successful service in the system of the Consolidated Telegraph and Electrical Subway Company, of New York. These terminal heads are also being used in the manholes and the conduit systems of the Brooklyn Rapid Transit Company, and also in a number of other large cities throughout the United States.

The engineers of the Spanish Government are installing Westinghouse motors in their gun shops at Trubia, and the Spanish Arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

A Metal Tool Rack.

As may be seen from the accompanying illustration, this is a metal tool rack, and



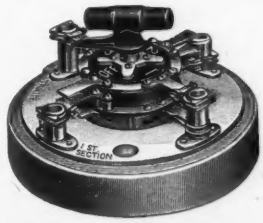
METAL WHEELED TOOL RACK.

is a particularly useful device for service in the machine room. The truck is made entirely of steel, the frame being constructed of heavy angle iron. The uprights are made of two by one inch by one-eighth inch channel iron, the sheet steel being No. 18 gauge stock with three-quarter inch steel rods running through the ends, as shown in the illustration. This truck is made in several sizes, the one here shown being made to carry steel "tote" boxes twenty-five inches long, twelve inches wide and five inches deep, with a total weight, when filled, of 3,000 pounds. The truck is mounted on wheels, and can easily be pushed around the shop when filled. A device of this kind obviates a great deal of heavy pushing and dragging of large numbers of small parts from one point of the machine room to another, and facilitates the handling of material very greatly.

This truck is made by the Lyon Metallic Manufacturing Company, 139 Fulton street, Chicago, Ill.

A New Heater Switch.

This heater switch has been carefully designed to withstand severe conditions of service for controlling heating rheo-



THREE-SECTION HEATER SWITCH.

stats. The accompanying illustration shows the switch with the cover removed, and, as may be easily seen, indicates the degree of heat in two ways; that is, by a pointer attached to the handle which points to the number on the cover, or by a dial, the numbers of which are shown through a hole in the cover.

This switch will operate on a 500-volt circuit at thirty-five amperes; controls heaters in three sections and will turn in either direction.

This switch is made by the well-known Hart & Hegeman Manufacturing Company, 92 Union place, Hartford, Ct.

An Old Rubber-Insulated Cable.

In the issue of December 6, 1902, the ELECTRICAL REVIEW published a short account of the raising of a section of submarine cable between Cienfuegos and Santiago, in the Caribbean Sea. This line was picked up in 1,350 fathoms of water in April, 1893, in order that the condition of the cable might be ascertained. The cable was covered with india-rubber, and the tests of the core show that after twenty years' submersion it was still in perfect electrical and mechanical condition, and that the copper had not suffered from the attacks of any sulphur in the rubber. Since the publication of this statement further data have been secured, to the effect that this cable was manufactured by Messrs. Hooper, cable manufacturers, Millwall, England, in 1873, and was laid in 1874, and that the cable is still in good working order.

The national convention on municipal ownership and public franchises will be held under the auspices of the New York Reform Club, Committee on City Affairs, in the rooms of the club, 233 Fifth avenue, New York city, on Wednesday, Thursday and Friday, February 25, 26 and 27, 1903. The programme includes an address of welcome by Mayor Low and John G. Agar, chairman, and brief contributions by William Wirt Howe, Clinton Rogers Woodruff, L. N. Case, Robert Donald, Edward T. Heyn, Charles T. Yerkes, Mayor Harrison, of Chicago; Edward M. Shepard, Louis D. Brandeis, James Blake Cahoon, and others. An interesting part of the programme is the discussion of "The European Experience of Public Ownership of Telephones," by Mr. Bennett, engineer for Glasgow and other municipal systems; "Argument for the Public Ownership of Telephones," by Professor Parsons, of the Boston Law School, this being answered by a paper on "The Superiority of Corporation Ownership of Telephones," by Mr. Union N. Bethell, general superintendent New York Telephone Company.

A System of Train Lighting by Electricity.

The most general method of lighting a railway car is to place several oil or gas lamps over the centre aisle. Happily, the use of oil is being replaced by some system of gas lighting, which gives a far more satisfactory light, but is not without its disadvantages and dangers. Scarcely a serious wreck occurs without a fire starting, and the rapidity with which this spreads tends to confirm the opinion that this is caused by the supply of oil or gas carried on the car.

A very serious disadvantage of gas lighting systems, as used to-day, arises from the position of the lamps. These are placed high up in the car in order that the large amount of heat given off and the gases arising from combustion of the illuminant may be quickly carried away; but this high position either calls for very large lamps or results in unsatisfactory illumination.

Now, since these disadvantages and dangers can be avoided by using electric lights, it at first seems strange that this means has not been put into more general use.

Electric train lighting may be accomplished by any one of three ways. A generating plant can be installed in the baggage car, or on the locomotive taking steam from the locomotive boiler. This system, so far as an entire train is considered, is satisfactory, but in railroad operation it is desirable to have each car a complete unit in itself, a condition not fulfilled here.

Accumulators may be carried on each car, rendering each car independent, but it is difficult to provide for changing the accumulators at a sufficient number of points, and it is generally impossible to depend upon charging the battery without moving it from the car.

The third system, and the one which seems to promise best, consists of a small generator driven from the car axle and a suitable accumulator which the former keeps charged. The accumulator is, of course, to supply light when the car is not running.

Although it seems a simple proposition to drive a dynamo from the car axle, there are some serious difficulties. Incandescent lamps require a constant voltage, independent of the speed of the car. The accumulator must be automatically cut out when the speed of the car reduces the voltage below that required for charging. The method of driving must be absolutely reliable, for it does not do to depend upon frequent inspection. The connection of the generator to the batteries must be changed automatically when the direction of the motion of the car is reversed. All of these points are well taken care of in the system described in this article.

The Moskowitz system of railway train lighting developed and built by the United States Light and Heating Company, consists of a small substantial generator, driven by a belt from the car axle, an automatic pole-changer for making the proper connections between the generator and the battery, a suitable battery of accumulators and an automatic regulator for maintaining a constant voltage.

The generator is a small four-pole machine. The field has a cylindrical form and is a solid steel casting. The field coils are wound on brass bobbins and carefully corded. The drum armature is covered with form-wound coils. But two brushes are needed, and these are held

THE MOTOR-GENERATOR SET AND CONTROLLING APPARATUS.

in convenient positions for inspection, on the ample commutator. All parts of the generator are interchangeable; the commutator can be slipped off the shaft for renewal, and the shaft itself can be removed from the core. The machine is enclosed, preventing dust or moisture from reaching the interior.

An important point is the method of suspension which must be of such character as to prevent injury to the generator from shocks and jars. In this system this is well taken care of by hanging the dynamo from the car sills by a stout piece of shafting which is itself supported on springs. The generator swings from this shaft as a pendulum. Motion is transmitted to the generator by a special type of belt which is not affected by the weather or dirt and which has a long life. The generator pulley has a wide flange for securely holding the belt in place. The belt is held taut by a compressed spring, the tension of which can be quickly adjusted without the use of tools, and will not change in spite of vibration. The belt drive has been selected by the engineers of this company after ten years' experience with systems of train lighting.

The pole-changer used in this system is of marked simplicity. To the end of the generator shaft is attached a disc in which a T-shaped latch slides, the head of the T being considerably heavier than the lower part. As the armature revolves at slow speeds, the weight of the latch causes it to slide down in the groove, and when in this position the lower part projects beyond the disc, and engaging in a suitable slot, throws the switch so as to make the proper connections between the generator and the battery. At about four miles per hour centrifugal force, acting upon the heavy head of the latch, throws it out of operation, so that the pole-changer is in action but a very short time at each start. This will prevent excessive wear and tear, and as the latch and other rubbing parts are hardened, the life should be long. The pole-changer switch is very simple and compact, and the whole arrangement is enclosed in a small cylindrical case attached to the frame of the generator.

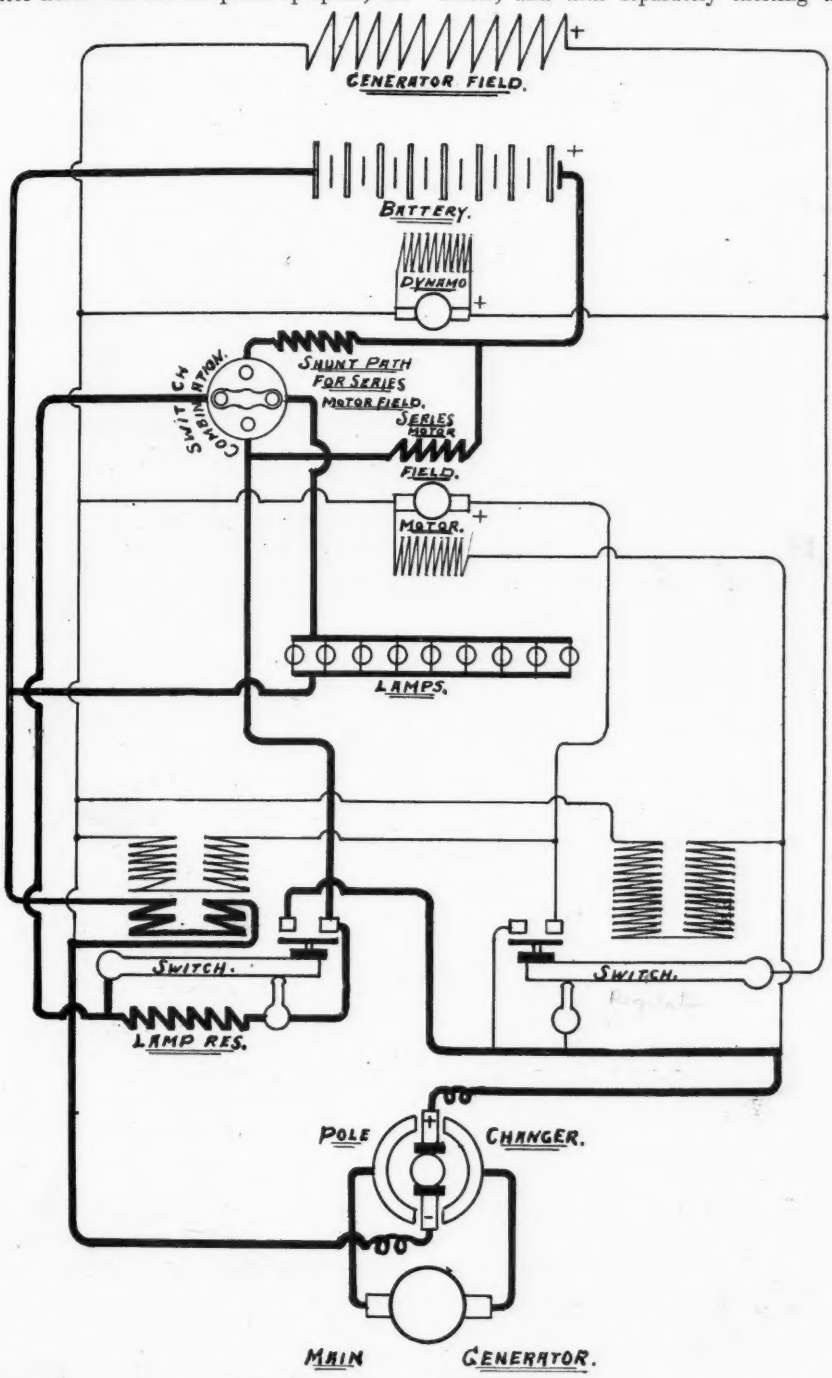
Any type of battery can be used for this system. The voltage adopted is thirty-two, requiring sixteen cells. This low voltage is, of course, entirely safe, and permits the use of incandescent lamps having short, thick filaments which are not easily affected by vibration of the car. These lamps can be placed where most effective, giving a better illumination than central lights where the same amount of light is used, or giving an equal satisfactory illumination for a less total quantity of light.

The all-essential part in any train-lighting system is the automatic regulator, and the regulator developed for this system has apparently reached a high stage of development. In it all ratchets, pawls and relays are done away with, the operation of the machine being entirely electrical. The main generator is excited by a small motor-generator. The generator part of this exciter is a small shunt-wound dynamo. The motor is compound wound. The two armatures are carried on the same shaft, the latter running in self-aligning oilless bearings. The two fields are formed in one casting, but are magnetically independent. The operation is as follows: When the speed of the main generator changes, the change in voltage arising from this alters the current through the series field of the regulator motor and thus changes the speed of the latter, and thereby the voltage of the exciting generator. This, of course, changes correspondingly the excitation of the main generator, bringing the voltage of the latter back to normal. The regulation secured in this way is good, as the pressure is held within one volt independent of the speed of the car and of the number of lamps in use. The regulator is very compact and is installed in the lower part of the case shown in the illustration.

The two magnetic switches shown in this illustration are the only automatic switches, excepting the pole-changer, of the whole system. The one on the right controls the exciter set as will be described presently. The other connects the generator to the car circuit.

Referring now to the wiring diagram, the switches are shown in the position they occupy when the car is started. As the car comes up to speed, the pole-

changer, which has properly connected the generator to the car circuit, is withdrawn from action. Tracing out the wiring circuits, it will be seen that the regulator control switch is connected across the generator terminals, as is also the exciting dynamo and the main generator field. As the car picks up speed, the exciting motor armature, and opens the main generator field circuit, leaving the latter connected across the exciter terminals. As the field of the exciting motor was already connected to the main circuit, this begins to run as a motor, driving the exciting dynamo as a generator, and thus separately exciting the



THE WIRING DIAGRAM AND CONNECTIONS.

main generator excites itself and also drives the exciting dynamo as a shunt motor. At about ten miles per hour the voltage of the main generator rises to about twenty-five, which sends sufficient current through the coils of the electromagnet operating the regulator switch, shown on the right, to attract its armature. This closes the circuit through the fields in the main generator. As the speed of the car increases, the voltage of the main generator increases until at about fifteen miles per hour it reaches thirty-five. This pressure sends sufficient current through the shunt coil of the automatic generator switch, shown on the left, to attract its armature, and thus connect the main generator to the car circuit, supplying the lamps and charging the battery. The action of this switch also cuts in the lamp resistance, this being necessary to enable the generator to charge the battery and run the lamps at the same time. As the car slows down, in making a stop, the action of the regulator is reversed. As the voltage falls off, the automatic generator switch drops its armature, disconnecting the generator from the circuit and short-circuiting the lamp resistance so that the lamps are connected directly across the battery. To ensure the operation of this switch in this way, a series winding is placed on the electromagnet so that if the voltage of the generator falls sufficiently to allow the battery to send a current backward through it, this current will demagnetize the magnet and cause the armature to drop and open the switch.

Occasionally it may be desirable to charge the batteries at a greater rate than would take place under the conditions just described. For this purpose, a combination switch is provided, as shown on the diagram, which when in one position completes the circuits as just described, but when turned through ninety degrees, cuts out the lamp circuit and throws a shunt resistance in parallel with the series field of the motor. This increases the speed of the latter, raises the voltage of the main generator, and charges the battery at a greater rate.

The automatic switches have been carefully designed, and operate without sparking. Although the main generator field is at one instant disconnected from the exciter there is no interruption of the field current and consequently no sparking. The regulator has been reduced to an exceedingly simple group of mechanisms, there being but two switches and the small motor-generator exciting set. In operation it seems to more than justify the confidence of its inventors, as it acts quickly and surely and there seems to be nothing to get out of order.

From this description, it will be seen that the Moskowitz system has been worked out with the idea of simplifying as far as possible all mechanisms and appliances. It is not the result of a few months, or even of a year or two of work, but has been developed by engineers who have been engaged on the problem of railway train lighting for the past ten years.

In addition to the advantages of better light and less heat, electric lighting has others. There is no objectionable odor, and when desirable, electric fans can be installed, adding greatly to the comfort of the passengers, and above all, there is the absence of danger from fire in case of accidents.

The inventor of the system is Mr. Morris Moskowitz, electrical engineer. The general offices are at 20 Broad street, New York, where Mr. A. Sanford Adler conducts the business of the company. The engineering department is temporarily located at 47 Ann street, New York city, where a model installation is now on exhibition.

A New Vacuum Condenser.

The accompanying illustrations will give a good idea of an apparatus which has been especially designed for a new process of condensing steam. Fig. 1 shows the assembled machine, the operating principle of which is to run the condenser by evaporating the condensing water. Fig. 2 shows a jet of water which is thrown into the tubes, and Fig. 3 the nozzle end of the spraying apparatus.

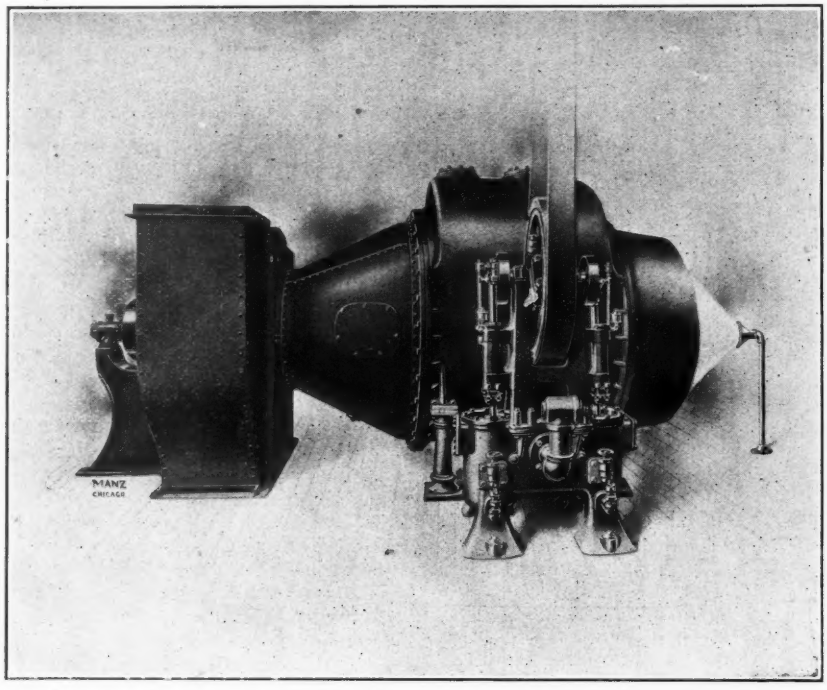


FIG. 1.—VACUUM CONDENSER, SHOWING BLOWER, SEPARATOR AND SPRAYING APPARATUS.

Water, in evaporating, requires over 900 British thermal units to be converted into steam for every pound evaporated. If the condenser can be so constructed as to be run by evaporating the condensing water, it is assumed that less water would have to be used, in about the ratio of 55 to 900. Upon this jet of water being thrown into the tubes, a part of this moisture is evaporated, under the action of a strong draught set up by the exhaust fan opposite. This evaporated water, in the form of a vapor, is rapidly removed, and each pound of vapor so removed carries with it 900 heat units. The excess water is caught in a well, and is returned to the jet again. The temperature of the entering water is immaterial so long as it is in a liquid state.

The manufacturer of this machine claims the following results under test: The temperature of the water increases to about 125 degrees Fahrenheit, and remains constant. Where 1,600 pounds of steam were condensed per hour, it required 0.7 to 0.8 of a pound for a pound of steam condensed, at the same time holding a vacuum of twenty-six inches mercury. In another test made on a condenser in Waynesboro, Pa., a vacuum of twenty-seven and one-half inches was maintained while 7,500 pounds of steam were condensed with eight pounds of water per pound of steam. In a test made on a small condenser in Chicago, 24,100 pounds of steam were condensed. Forty-eight thousand pounds of water were thrown into the tubes, 33,600 pounds returned, and 14,390 pounds were thrown off in the form of vapor. This test showed about 0.7 of a pound per pound of steam. The vacuum was twenty-four inches with an ordinary steam-actuated air pump.

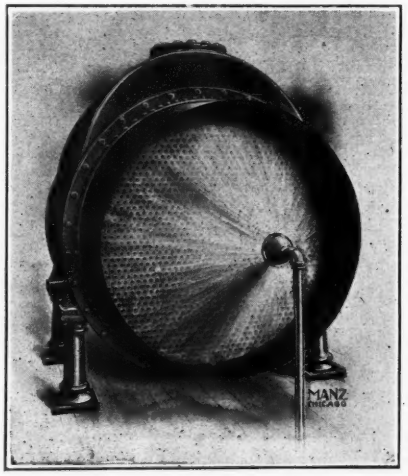


FIG. 2.—THE SPRAY END—MOISTURE BEING INSERTED INTO THE TUBES.

This condenser is practically a combination of surface condenser and cooling tower. All the benefits of high vacuum are obtained, amounting to twenty-nine per cent in triple-expansion engines, and twenty-three per cent in compound high-speed engines. It is stated that this machine is finding a field in almost all lines of practical engineering, not only in power plants, where there is every necessity for economy of fuel, but also in coal mining districts, where this is not generally a limiting feature.

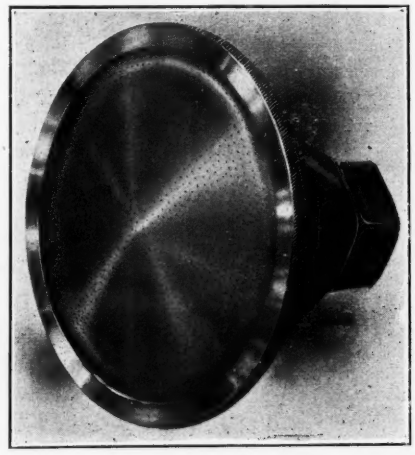


FIG. 3. THE NOZZLE.

The machine is manufactured by the Steam and Electrical Equipment Company, of Pittsburg, Pa.

Exports of Manufactures from the United States—1902.

Exports of manufactures show a marked increase in the calendar year 1902 as compared with 1901. The total value of the 1902 exports of manufactures, as shown by the figures of the Treasury Bureau of Statistics, is $410,650,967 against $395,144,030 in 1901, an increase of $15,500,000. Exportations of manufactures of iron and steel for the calendar year 1902 were $97,892,036. The corresponding figure for copper was $45,486,598. Nearly all the important manufactures entering into our export trade show an increase, the chief exceptions being iron and steel and refined mineral oil. Iron and steel manufactures show a decrease of over $4,500,000 and mineral oils a reduction of $4,000,000. Copper manufactures showed the largest gain, $12,000,000.

Friction Water-Wheel Governors.

The water-wheel governor shown in the accompanying illustrations, the maker claims, has been thoroughly perfected in all its details, and before generally offering it to the trade, has been in operation for over a year under varying conditions. A severe test of this type of governor has been made at the three-phase power plant of the United States Arsenal, at Rock Island, Ill., and has proved highly satisfactory. This installation when complete will consist of twenty 50-inch turbines and four governors, and will furnish light, power and heat for all of the Arsenal buildings. The total capacity of the station will be 1,750 kilowatts. At present, fourteen wheels and three governors are in use. The governors are geared to close the gates from full open in six seconds, and with the changes due to the operation of large induction motors, the greatest temporary fluctuation does not exceed three per cent.

FIG. 1.—THE GOVERNOR AND THE GEAR AND SHAFT DEVICE.

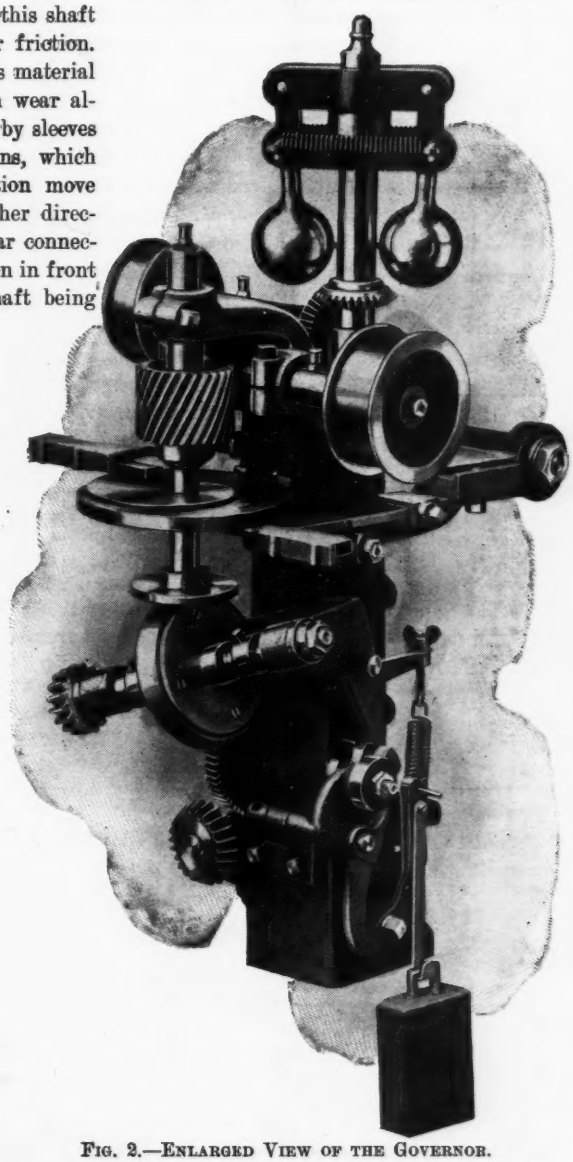


FIG. 2.—ENLARGED VIEW OF THE GOVERNOR.

The Ottawa & Hull Power and Manufacturing Company, of Hull, Quebec, has had one of these governors in use for some time on its temporary plant, and is now installing two in its large station, which, when complete, will have an output of 10,000 horse-power. Each governor will control four 51-inch horizontal cylinder gate turbines, operating the full range of the gate in five seconds. Each set of the four wheels is connected to a 1,500-kilowatt generator. This and several other installations have already been operated with success by these governors, the construction of which is shown in Figs. 1 and 2.

The power to operate the governor is supplied from the main shaft of the water-wheel and is delivered to the shaft of the governor by the large pulley. This is seen in the rear of Fig. 1. On this shaft is mounted a compressed paper friction. The introduction and use of this material for frictions make trouble from wear almost inappreciable. Supported by sleeves on this main shaft are two pans, which when pressed against the friction move the gates of the turbines in either direction, by means of a suitable gear connection, to an intermediate shaft seen in front of Fig. 1, this intermediate shaft being connected in turn to the turbine gate shaft.

The speeder balls of the governor are spirally driven from the main shaft of the installation. There is also a cam continuously revolved by means of a belt and a spiral gear, this being plainly seen in the foreground of Fig. 1. Fig. 2 is an enlarged view of the speeder balls and the spiral gear connection. As the speed changes, the rod of the speeder rises and lowers, carrying with it the tappet arms and tappets. These tappets can be seen, one above and one below the cam above mentioned. As soon as a change of speed occurs, either one or the other of the tappets, as the condition demands, is engaged by the cam and forced out from its centre.

This motion is then conveyed through suitable crank shafts to the main shaft, on which the friction is mounted, and as this shaft is forced back and forth, the friction is brought to bear on either the opening or closing pan. When the speed is normal, this cam revolves between the upper and lower tappets without engaging either. The cam mechanism is capable of close adjustment, enabling the governor to act on a very slight change of speed.

Just below the cam and fastened to the same shaft is a concave disc. Below this disc is a compensating wheel which travels loosely upon an oblique shaft. This compensating wheel, oblique shaft and disc are clearly seen in both Fig. 1 and Fig. 2. This oblique shaft is geared

to the intermediate shaft so that it revolves only when there is a movement of the gates. This is also provided with a square thread, as is the compensating wheel. The object of this device is to avoid racing of the governor, the principle being as follows: When the speed is normal, the compensating wheel seeks the centre of the disc, which is supported upon it, because this disc is constantly revolving with the cam. When a movement of the gates occurs, the compensating shaft is revolved and the wheel will travel along its shaft in such a direction that it separates the cam from the tappet when the gate has been moved to that point which will give the correct speed after the momentum of the machinery has been overcome. During this interval, the disc will run the compensating wheel to the central position. This device can be designed to properly compensate for any condition, as the time element can be varied not only by varying the pitch of the screw, but also by varying the speed of the oblique shaft with a change of gears.

This governor is manufactured by the Woodward Governor Company, Rockford, Ill.

Automatic Start Induction Motors for Single-Phase Current.

These motors operate on the induction principle, and, consequently, have no insulated wire on the armature and no brushes or commutator, with small parts requiring adjustment, renewal or repair. The motors are well made, durable, strong and efficient, and are much more strongly built than is the usual practice with motors of this size. The motors shown in the accompanying engravings are of one-tenth and one-twentieth horsepower. The bearings are self-oiling, with oil cups so made that the motor can

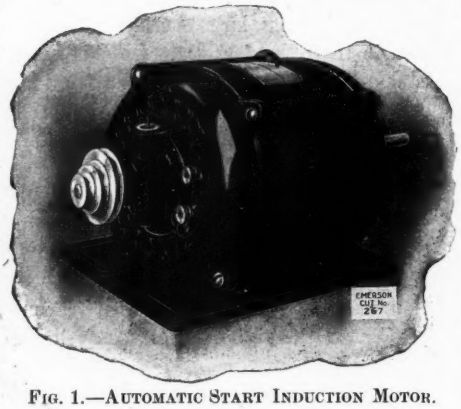


Fig. 1.—Automatic Start Induction Motor.

be operated in an inverted position by changing the relative position of the solid plug at the bottom of the oil-well chamber and the screw cover closing on top of the oil well, at the same time placing the cotton wicking in the proper position.

The automatic device in this motor is very simple from a mechanical standpoint, and is operated with constant success in a remarkable number of equipments. The one-twentieth horse-power motor consumes about ninety watts, and the motor actually develops a tension which would correspond to a pull of three pounds from a pulley one inch in diameter on a motor running at 1,650 revolutions per minute, or one and one-half pounds on a motor running at 3,300 revolutions per minute. From this it will be seen that an extremely small belt will handle the entire power of the motor, and anything added to the stiffness or weight of the belt will only waste a large part of its power. For many purposes a rawhide string is heavy enough. The base of the motor is provided with slots for fastening the screws, so that by loosening these screws the motor can be easily moved to take up slack or stretch the belt. These motors are adapted only for service which requires the moving of the very lightest machinery, and should always be run continuously at full rated power.

These motors do not develop their full torque until approximately full speed has been reached. By reason of this fact they will not start their full rated load. Where the full power of the motor is needed in starting, the motor is connected to the apparatus to operate in such a way as to permit the motor to reach full speed before throwing on the load. This is done by means of tight and loose pulleys, friction discs, and idler pulley acting as a belt tightener, or some other simple mechanical device.

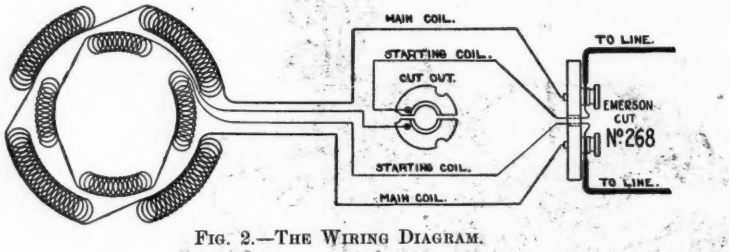


Fig. 2.—The Wiring Diagram.

The main field coils are connected in series, and one end of these coils is connected to each binding-post on the motor. The wires which pass through the binding-post plate, and which are connected to the binding-posts on the outside of the motor, are the ends of the starting coils, and in order to reverse the direction of rotation of the motor it is only necessary to reverse the connections of these two wires.

Fig. 1 shows the general appearance of the motor; Fig. 2 the wiring diagram, and Fig. 3 a group of these motors driving small-pressure blowers.

These motors are made by the Emerson Electric Manufacturing Company, St. Louis, Mo.

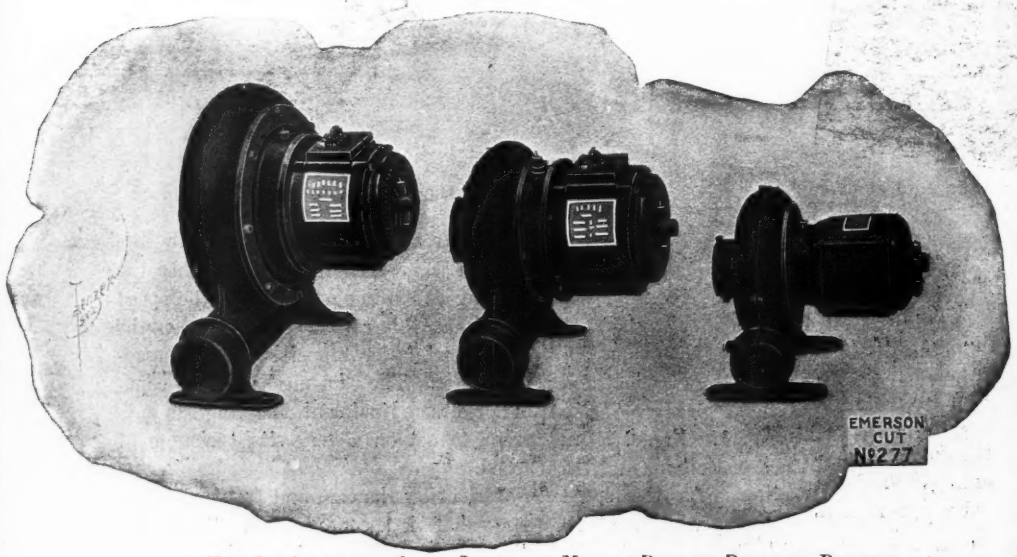


Fig. 3.—Automatic Start Induction Motors Driving Pressure Blowers.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

PITTSBURG TRACTION SYSTEM TO BE ENLARGED—It has been announced by President Calvery, of the Pittsburg Railway Company, that the completion of the power plant on Brunots Island will be inaugurated by the addition of 100 more cars on the various systems of the company, probably in September. The present power facilities of the company are taxed to the limit, but it is expected that the new cars and increased power facilities on the completion of the Brunots Island plant will give the company equipment to handle the growing traffic and abate the present congestion.

AMERICAN TROLLEYS FOR FRANCE—Americans have secured the concession for the construction and operation of what promises to be one of the most important electric traction systems in Europe. This franchise, in which it is stated John Hays Hammond and Henry A. Buttens, of San Francisco, are interested prominently, calls for the building of a road 275 miles in length, to connect Lille, one of the most important commercial centres of France, with Roubaix and Tourcoing, in the French coal region. The cost of construction and equipment is put at about $7,000,000. In addition to operating the electric road, a large power station is to be built in the vicinity of the coal mines for the purpose of generating current to operate mining machinery.

CHICAGO TELEPHONE PROFITS INCREASE—The net earnings of the Chicago Telephone Company in 1902 were $1,202,471, an increase of about $120,000 over the net earnings of 1901. These increased earnings, however, were made on a capitalization that had been enlarged $3,000,000 over that in use in 1901. The surplus of $127,278 shows a small increase over that of the preceding years. The comparative statements of income for the last two years, as presented at the annual meeting, are as follows: Gross revenue, 1901, $3,775,001; 1902, $4,570,805; gross expenses, operation, taxes, maintenance and reserve for deferred maintenance, 1901, $2,691,129; 1902, $3,368,334; dividends, 1901, $960,000; 1902, $1,075,192. The increase in the number of telephone stations installed in 1902 was 25,614, making the total December 31, 1902, 79,043.

NEW NIAGARA POWER COMPANY—It is stated that a new power company, to be known as the Niagara Falls Power Company and to be financed by Toronto capital, will commence operations immediately after the government agrees to give it the right to develop power. Current will be brought to Toronto by cable over a distance of ninety miles. It is expected that 20,000 horse-power, for use within the city of Toronto, will be produced at first, but that 125,000 horse-power will be generated when the plant is worked to its full capacity. The company intends to sell power to municipalities and firms along the transmission line. It is also stated that the power will be used to operate the Toronto street railway and the Toronto Electric Light Company's plant. It is expected that the expenditure will total about $5,000,000, and the work is to be completed within two years or less.

PERSONAL MENTION.

MR. M. E. BAIRD has resigned as the manager of the New York office of the Milwaukee Electric Company, and will be succeeded by Mr. S. H. Sharpsteen.

MR. A. EDWARD NEWTON, president of the Cutter Company, Philadelphia, reached New York during the present week on the Oceanic after a trip to England and the Continent.

MR. GEORGE A. DAMON, of the Arnold Electric Power Station Company, Chicago, Ill., was in Montreal last week and gave a lecture on power-plant engineering to the senior class of the department of electrical engineering, McGill University.

MR. KERN DODGE, of the firm of Dodge & Day, Philadelphia, Pa., read a paper before the Franklin Institute on January 22, entitled "Power Cranes in Machine Shops." This paper, with illustrations, is to be printed in full in the journal of the Franklin Institute.

MR. CARL L. DE MURALT, who will be remembered by members of the American Institute of Electrical Engineers as having read a very interesting paper on the polyphase railways of Europe, is again in the United States, where he expects to make a considerable stay.

MR. FRANK D. LAWRENCE, president of the Standard Electrical Company, Cincinnati, Ohio, visited New York last week and renewed many pleasant friendships. Mr. Lawrence reports much improvement in Cincinnati and corresponding expansion in the electrical industry in that city.

MANVILLE-ROMAINE—On Wednesday, January 28, in the Church of the Heavenly Rest, New York city, Miss Henrietta Estelle Romaine, daughter of Frank Hall Romaine, was married to Hiram Edward Manville, of Milwaukee, Wis., by the Rev. Dr. D. Parker Morgan, rector. A reception and wedding breakfast at Sherry's followed the ceremony, a number of prominent people being present.

MR. IRVING C. BULL, assistant to the professor of metallurgy, Columbia School of Mines, New York city, will deliver a lecture on Wednesday evening, February 11, at eight o'clock, in room No. 309, Havemeyer Hall, Columbia University. The subject of Mr. Bull's lecture will be "High Temperature Measurements." This lecture will be illustrated by lantern slides and demonstrations of the more important pyrometers used in metallurgical processes.

MR. CORWIN H. SPENCER, chairman of the committee on ceremonies of the St. Louis Purchase Exposition, has announced that the grounds and buildings will be dedicated on April 30 by the President of the United States, and an address will be delivered by the Hon. Grover Cleveland, ex-President of the United States. The grand marshal of the day will be Major-General Henry C. Corbin, United States Army. The ceremonies will include a military pageant preceding the programme of dedication, the exercises taking place in the Palace of Liberal Arts, and an extremely elaborate fireworks display will be effected.

MR. WILLIAM J. HAMMER, the well-known consulting engineer of New York city, has had reprinted a number of papers of which he is the author. One is on the telephonograph, and is reprinted from the Smithsonian report for 1901. The others are all reprints from the transactions of the American Institute of Electrical Engineers, and relate, respectively, to papers on "Edison's Tungstate Calcium Lamp," "The Nernst Lamp," "Radium, Polonium and Actinium," "Important European Electrical and Engineering Developments at the Close of the Nineteenth Century," and "An Automatic Telephone Operator."

MR. RAY D. LILLIBRIDGE announces that the statement that the Stanley Electric Manufacturing Company has sold out to the General Electric Company is unauthorized. "It is true," he says, "that negotiations for a change of ownership of control of the Stanley company are pending; but in this connection it should be stated that, notwithstanding all reports, the control of the Stanley company has never passed into the hands of William C. Whitney. The plan to increase the capital stock to $10,000,000 has not been abandoned, and the permanency and enlargement of the works at Pittsfield is one of the details agreed upon in any event."

MR. GEORGE H. GIBSON has resigned his position with the Westinghouse Companies' Publishing Department, Pittsburg, Pa., to accept an appointment with the B. F. Sturtevant Company, Jamaica Plain Station, Boston, Mass., the well-known manufacturer of blowers, heating, ventilating and forced draught apparatus, electrical machinery and steam engines. Mr. Gibson was formerly a member of the editorial staff of the *Engineering News*, of New York city, and is a graduate of the engineering school of the University of Oregon. During his connection with the publishing department of the Westinghouse companies, Mr. Gibson has made for himself an enviable position in the range of friendship, his unvarying courtesy having won for him the commendation of every one with whom he was necessarily placed in communication.

TELEPHONE AND TELEGRAPH.

SAVONIA, N. Y.—The Addison & Bath telephone system is being extended to Hammondsport.

DES MOINES, IOWA—The Farmers' Mutual Telephone Company will put in a $7,000 exchange at Yarmouth.

DIXON, ILL.—The Interstate Telephone Company is installing a new board at Morrison with a capacity of 450 telephones.

HIGHLAND, N. Y.—The Southern New York Toll Company is erecting a telephone line from this village to New Paltz by way of Clintondale.

PULASKI, N. Y.—A franchise has been granted by the board of trustees to the Bell Telephone Company to run its wires through the streets of this village.

RICHMOND, VA.—Negotiations are on foot looking to the sale of the Southside Telephone Company, operating in Manchester and Chesterfield, to the Southern Bell Company.

ELKTON, MD.—A new telephone line is likely to be built down the Maryland Peninsula by the Eastern Telephone and Telegraph Company. A representative of the company has been looking over the field.

JACKSONVILLE, FLA.—A charter has been granted to the Gulf Coast Telephone and Telegraph Company, of Milton, to construct, own and operate telephone and telegraph lines. Lee Daniel, George B. Prior and Munroe Campbell are the incorporators.

ALTOONA, PA.—The Western Union Telegraph Company has a large force of linemen engaged in stringing a cable containing thirteen wires from Tyrone to Altoona. The poles of the long-distance telephone line are being used to support the cable.

BEAVER DAM, OHIO—The Beaver Dam Home Telephone Company has been incorporated by Edwin Fledderjohann, C. C. Heller, Allen Phillips, A. H. Heller and W. H. Fledderjohann, to construct local lines. The company has an authorized capital of $15,000.

ELMIRA, N. Y.—It has been announced that the New York & Pennsylvania Telephone and Telegraph Company will soon erect buildings for exchanges at Geneva, Cortland and Auburn, similar to the exchanges recently opened at Ithaca. Plans for the buildings are now being drawn up.

NEW HAVEN, CT.—A bill has been introduced in the legislature by Representative F. A. Haugh, of Canton, to repeal the statute passed two years ago which prevents the location of independent telephone companies in Connecticut without a special act of the general assembly and without the consent of the superior court.

ALBANY, N. Y.—The Perry Telephone Company, with a capital of $10,000, has been organized to construct a line to connect the towns and villages of Wyoming, a local line in the town of Perry and in Livingston and Genesee counties. The directors of the company are: C. M. Perry, Loyd P. Benedict, C. W. Smith, of Perry.

TROY, N. Y.—The Easton & South Cambridge Telephone Company has been incorporated to build and operate lines from the village of South Cambridge to the villages of Easton and North Easton, with spurs running elsewhere in the vicinity. The directors of the company are: Edward Whiteside, Lawrence J. Dorsey, E. J. Skipp, L. W. Borden, F. O. Ives, E. H. Borden and Paul D. Ives.

BINGHAMTON, N. Y.—A deed has been filed transferring the Binghamton Telephone Company's plant and business to the York State Telephone Company. The consideration is $140,000 in capital stock and $70,000 in bonds of the York State Telephone Company. Operations are being pushed rapidly in all parts of the state to connect the different local companies, so as to give a good independent long-distance service.

CONNELSVILLE, PA.—Application has been made for a charter for the Union Telephone and Telegraph Company, which will be capitalized at $3,000,000. It is said that eastern capital will finance the company, the object of which will be to build telephone and telegraph lines from eastern cities to Pittsburg, connecting with lines west and south, and to complete a system of telephone service to embrace Somerset, Fayette, Washington, Westmoreland and Allegheny counties. Work on the new system will commence next spring, and will be pushed as rapidly as possible.

ELECTRIC LIGHTING.

DALLASTOWN, PA.—An electric light plant is to be built here.

DUBUQUE, IOWA—The Union Electric Company is planning to build a $200,000 power plant the coming summer.

LAUREL, DEL.—This town proposes to issue bonds for $20,000 for the purpose of establishing an electric light plant.

NORWICH, CT.—It has been voted to appropriate the sum of $15,000 for the purpose of reconstructing the present electric light plant.

ANDERSON, IND.—The electric board has decided to make improvements to the incandescent plant which will amount to $20,000.

NAVARRE, OHIO—The electric plant for furnishing the town with light has been completed and put in operation, and is giving great satisfaction.

VENUS, TEX.—It is stated that a movement is on foot to build an electric light plant here, and that three-fourths of the stock has been subscribed, all by home people.

HOLYOKE, MASS.—The gas and electric plant of Holyoke, owned by the Holyoke Water Power Company, has passed into the hands of the city, the price being $720,000.

RED JACKET, MICH.—This village has granted a thirty-year franchise for heating and lighting to John Burder, of Calumet, who will organize a local company to erect a central lighting and heating plant.

ONEIDA, N. Y.—The Madison County Gas and Electric Company has been awarded the contract for lighting the streets of Oneida for the next two years. The company is to receive $6,500 per year for the service.

WASHINGTON, D. C.—A mortgage has been placed on file by the Potomac Electric Power Company, pledging all its property rights and franchises to secure the payment of $2,500,000 in bonds in twenty-five years. The bonds will bear interest at the rate of four and one-half per cent per annum. The Commercial Trust Company, of New York, is named as trustee.

ATLANTA, GA.—The petition for a charter for the Central Light and Power Company has been filed. The incorporators of the company are given as M. R. Wilkinson, J. R. Gordon, S. E. Smith and F. H. Miles, of Fulton County, and T. L. Hughes, of Florida. The company is to be capitalized at $50,000. The object of the company is to furnish light, heat and power to the towns of the state.

ROCHESTER, N. Y.—New York and New Jersey capitalists have organized the Rochester Light and Power Company, and it has been incorporated at Albany. The capital stock is $500,000, and the directors are: Edward J. Patterson, of New York city; Harry L. Snyder, of Montclair, N. J.; G. L. Wakefield, Francis P. Ross and Samuel S. Perry, all of New York. The company will operate under a franchise obtained many years ago by the Central Light and Power Company, which gives liberal concessions.

COLON, MICH.—Work has been resumed on the dam in the St. Joseph River. The undertaking includes building three others between Colon and Three Rivers, with a combined horse-power of 4,000. Five hundred thousand dollars has lately been raised by the company in order to push the enterprise and secure the cooperation of an eastern firm controlling $15,000,000. The power will be utilized for the establishment of local industries first, and the balance sold to neighboring towns. A trolley line from Kalamazoo to Elkhart is already projected.

NORWICH, CT.—The Willimantic and Electric Company has served notice on the towns of Willimantic and Windham that it will make application to the next general assembly for an increase of its capital stock from $200,000 to $300,000, and for the privilege of issuing bonds to the full amount of its capital stock. It will also ask to be empowered to issue its promissory note for the purpose of raising money. The reason given for the increase is that the company is now making extensive improvements to its plant which are greatly in excess of the original estimates, and that the funds realized are not sufficient to meet the outlay.

ELECTRICAL SECURITIES.

During the past week, if there was anything for which the market was significant, it was in the continued dullness which has characterized it for some time past. It has been stated that the low record for the year so far was made during the middle of the week, and the commission houses are complaining very much over the continued lack of interest manifestd generally. This condition is thought by many professional speculators to indicate that the outside buyers will keep aloof from the market till some development of a very large nature will give them considerably more encouragement than they can see at present. The daily papers still continue to excite the minds of their readers with startling statements as to the progress of the Venezuelan affair. There is, however, but little positive attention being paid to this condition, as there is extant the most practical belief that the whole affair will be amicably and equitably arranged.

New York:	*Closing.*
Brooklyn Rapid Transit	67⅜
Consolidated Gas	217¼
General Electric	196¾
Kings County Electric	220
Manhattan Elevated	144½
Metropolitan Street Railway	136½
New York & New Jersey Telephone	164
Westinghouse Manufacturing Company	215

The Westinghouse Electric and Manufacturing directors have declared the regular quarterly dividend of 1¾ per cent upon the assenting stock, payable February 16. Books closed February 2 and reopen February 17.

At the meeting of the board of directors of the Brooklyn Rapid Transit Company, Mr. Edwin W. Winter was elected president to succeed Mr. J. L. Greatsinger. Mr. Winter is a western man.

Boston:	*Closing.*
American Telephone and Telegraph	162
Edison Electric Illuminating	275
Massachusetts Electric	92½
New England Telephone	135
Western Telephone & Telegraph preferred	99

The New England Telephone and Telegraph Company has declared a regular quarterly dividend of 1½ per cent, payable February 16. Transfer books close January 30 and reopen February 16.

The Boston Elevated Railway Company has declared a regular semi-annual dividend of 3 per cent, payable February 16 to stock of record January 31. Books close January 31 and reopen February 17.

Philadelphia:	*Closing.*
Electric Company of America	9 1/16
Electric Storage Battery common	78
Electric Storage Battery preferred	80
Philadelphia Electric	7 15/16
Union Traction	46¾
United Gas Improvement	115⅞

Chicago:	*Closing.*
Chicago Edison Light	180
Chicago Telephone	156
Metropolitan Elevated preferred	86
National Carbon common	26
National Carbon preferred	100
Union Traction common	11¾
Union Traction preferred	47

The report of the Northwestern Elevated Company, of Chicago, for the year ended December 31, is as follows: Gross, $1,410,998, a gain of $432,232 over the preceding year; expenses, $464,401, an increase of $141,756 over those for 1901; net earnings, $946,597, an increase of $290,476 over 1901.

ELECTRIC RAILWAYS.

AKRON, OHIO—The Northern Ohio Traction Company has deeded its property to the Northern Ohio Traction and Light Company. The consideration was $1. The company will issue 7,500 $1,000 bonds.

CLINTON, IOWA—An interurban electric railway is to be built between this city and Davenport, a distance of forty-three miles, by the Illinois & Iowa Railway. Work is to be begun in March, and the company expects to have its cars in operation by the first of August.

SAULT STE. MARIE, MICH.—It is reported that an electric railroad will be built between the Soo and St. Ignace early in the spring. Power will be supplied by the Consolidated Lake Superior Company, and it is said that the financing of the road will be done by Pennsylvania interests.

ALLENTOWN, PA.—Surveyors of the Easton & Washington Traction Company have made a survey for the proposed power-house of the company, and are now at work on the complete map of the forty-mile route connecting Easton, Hackettstown, Belvidere, Phillipsburg and Washington, N. J.

CHICAGO, ILL.—The Chicago & Milwaukee Electric Railway Company has been sold to the Milwaukee Electric Railroad Company. The stockholders and management will remain practically the same, but the stock of the company will be increased $1,000,000 and operations considerably extended.

NEW YORK, N. Y.—The Elizabethport, Amboy & Long Branch Railway Company has been incorporated with a capital stock of $500,000. It will operate a trolley line between the points named in the title of the company. The incorporators are: Edwin Burman, of Sayreville; N. Parker Runyon, of Perth Amboy, and Andrew Kirkpatrick, of Newark.

FLORENCE, COL.—Thomas Robinson has announced that the Florence Electric Street Railroad will be an interurban service. The lines will not only be built to Canon City, the coal camps and Portland but to Pueblo and Colorado Springs. The first work will be to put the line through to Canon City and other parts of the county at a cost of about $500,000, and the extension to the Springs and Pueblo will take place later. Bonds in the sum of $2,700,000 have been floated, and $2,200,000 will be reserved for the construction and equipment of the road to outside points. The entire line as now planned will be 125 miles in length.

BALTIMORE, MD.—The United Railways and Electric Company has signed a contract for the perpetual lease of the Baltimore, Sparrows Point & Chesapeake Railway, forty-three miles of track, which now assures the united company complete control of every suburban line as well as the entire street railway system of Baltimore city. Under the deal the United Railways Company guarantees principal and interest of an issue of $2,000,000 bonds by the Bay Shore Company, as the new acquisition will be known. The line will connect this city by trolley with the Maryland Steel Works at Sparrows Point and will be extended to and along the Chesapeake Bay shore below North Point, where summer resorts will be established.

OBITUARY NOTICES.

MR. WILLIAM GRAY, inventor of the Gray telephone pay station, died at his home in Hartford, Ct., on the evening of January 23. Mr. Gray was born in Tariffville, Ct., about fifty-one years ago. He was of an inventive turn of mind, and has produced devices and processes for a number of interests. The Gray Telephone Pay Station Company has become an established Hartford industry, and for the past twelve years Mr. Gray had given his entire time to the development of the pay station telephone, holding a responsible position as general manager of the company.

MR. SAMUEL M. BRYAN, ex-president of the Chesapeake & Potomac Telephone Company, and well known in Baltimore and Washington financial circles, died early on the morning of January 23 at his residence at Ruxton, Baltimore County. When the Chesapeake & Potomac Telephone Company was incorporated, Mr. Bryan was one of the leading spirits in the venture, and, as its business manager, did much to enlarge the business of the corporation. In recognition of his administrative abilities, he was made president of the company, which position he occupied for sixteen years, retiring about five years ago. Since that time he has not been actively engaged in business of any kind. A son, Mr. Charles E. Bryan, is now connected with the Baltimore branch of the company. Besides this son, Mr. Bryan is survived by a widow and three other children—Miss Helen G. Bryan, who makes her home in Boston, Mass.; Mr. Frederick A. Bryan and Mr. Edgar A. Bryan.

INDUSTRIAL ITEMS.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has issued a series of flyers descriptive of motor applications, and also a short treatise on counter-shaft motors and increased cutting speeds.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for "Packard" incandescent lamps, states that while its factory is large enough to quickly handle any size order, the conditions are such that careful and personal attention is given to each contract.

THE BALL ENGINE COMPANY, Erie, Pa., manufacturer of automatic cut-off engines, has been very successful in its foreign business. The engines used in the Seoul Electric Company, of Korea, described in the ELECTRICAL REVIEW of January 10, were manufactured by this company.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports a most gratifying commendation from architects and electrical engineers who have examined and tested its new 1903 model push switch. This switch requires but one style of plate for all conduit boxes, thus avoiding the confusion of an alphabet of different sizes and patterns of plates.

THE LIONEL MANUFACTURING COMPANY, Incorporated, 24 and 26 Murray street, New York city, manufactures miniature electric cars and fans with full accessories for window display and holiday gifts. A feature of this company's manufacture is battery fans wound for either two and one-half volts, two amperes, or six volts and eight amperes. These are not by any means toys, but practical breeze-producing apparatus.

THE OTIS ELEVATOR COMPANY, New York city, has recently closed a contract with the North German Lloyd Steamship Company, Hoboken, N. J., for ten electric passenger elevators; with the Kean, Van Cortland & Company Building, 28 and 32 Pine street, New York city, for four hydraulic elevators; with the Hotel Willard, Washington, D. C., for four hydraulic elevators and two electric elevators, and with the Belvidere Hotel, Baltimore, Md., for seven plunger elevators with a car travel of 160 feet.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York and Chicago, has just issued its catalogue No. 14, and also the price-list applying to this catalogue. The Manhattan company's catalogue is a liberal education on the electrical supplies necessary for electric light, household, telephone, telegraph and railway equipments. The illustrations are all clearly printed, and the descriptions are comprehensive and easily understood. The book is supplemented by a carefully prepared index, and is very valuable to the practising electrician.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, is placing on the market an apparatus designated as the "Electrotherm." This is an electrical substitute for the hot water bag or bottle and is composed of wires insulated by asbestos woven into a light and flexible sheet or pad. When attached to the ordinary incandescent lamp socket, the wires offer sufficient resistance to the current to produce a constant and uniform degree of heat. The "Electrotherm" is made for any voltage from 5 to 125 volts, and at 110 volts requires a maximum current of one-half ampere and at fifty volts one ampere.

THE STOREY MOTOR AND ELECTRIC COMPANY, Incorporated, 321 Sussex street, Harrison, N. J., has an interesting letter from the Putnam Machine Company, of Fitchburg, Mass., describing some cuts made with a fourteen-inch lathe upon which a three-quarter-horse-power Storey motor has been installed. The New York office of Manning, Maxwell & Moore has some interesting samples of work done on this lathe, one sample being called attention to as being an especially interesting piece of screw cutting. The Putnam Machine Company states that this could not be done on any belt-driven lathe without stopping the lathe and pulling the belt by hand.

THE AMERICAN INSULATED WIRE AND CABLE COMPANY, Chicago, Ill., has completed the first year of a very prosperous business by tendering to all of its employés a banquet on the evening of January 10. This event took place at the Briggs House, and those who were fortunate enough to be present partook of an excellent menu and wound up the evening's enjoyment with a visit to a down-town theatre. The American Insulated Wire and Cable Company has been in business but a short time, and has made rapid strides to success, having increased its plant to four times its original size. The present capacity is 500,000 pounds of weather-proof wire per month.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently adopted a policy concerning the renewal of plates in Exide batteries which will attract the favorable attention of users of electric vehicles. This new scheme reduces to a minimum the cost of these new parts. Information regarding this may be secured from any of the sales offices of the company, or from the Exide battery depots at Philadelphia, New York, Chicago, St. Louis, Buffalo, Rochester and Detroit. The company calls attention to the fact that at the recent automobile show at Madison Square Garden, New York, of eight manufacturers exhibiting electric vehicles, six used Exide batteries.

THE STANDARD POLE AND TIE COMPANY, 135 Front street, New York city, has completed the work on its cross-arm mill at Brooksville, Fla., situated in Hernando County, in the centre of the Florida heart pine belt. This mill has a capacity of 40,000 feet per day, and is equipped to turn out arms of any dimension and bore. Shipments have already been made, and the company is in excellent position to fill all orders and make prompt deliveries to any point. All arms turned out are subjected to careful inspection before shipment, and, upon request, samples will be furnished. As may be noted above, the company is now established in its new offices in the Venezuela Building, on Front street.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has secured the contract to install its automatic telephone apparatus in Waterloo and other towns where the Commonwealth Telephone Company operates. The Commonwealth Telephone Company was organized during the latter part of January, with headquarters at Waterloo, Iowa, and secured control of the following properties in that state: Cedar Valley Telephone Company, the County Telephone and Telegraph Company, the Waverly telephone system, the Hardin County telephone system, the Parkersburg telephone system, and the La Porte City telephone system. The new company is capitalized at $900,000, and will operate in eight Iowa counties.

THE NORDEN-BITTNER ELECTRIC COMPANY, New York city, secured the contract for the electrical display and decoration for the Arion Ball, held at Madison Square Garden, New York, February 6. This company uses in its decorative work the "Norbitt" temporary socket manufactured by the Crouse-Hinds Electric Company, which is the sole manufacturer and licensee. The Norden-Bittner Electric Company is the inventor of the "Norbitt" specialties. The Crouse-Hinds Electric Company states that this contract was awarded for the "Norbitt" temporary decorative socket after a thorough investigation of decorative systems by Mr. Hildebrandt, chairman of the decorative committee of the Arion Society.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., issues regularly a small monthly sheet of information, the avowed intention of which is to advance the interests of Dixon's graphite productions, and to establish a better understanding in regard to the different forms of graphite and their respective uses. This contains much interesting data of value and instruction to the user of graphite in any form. The company has just issued a souvenir of an inspection trip made by the American Society of Civil Engineers to the new terminal of the North German Lloyd Steamship Company. This shows the pier in the different stages of construction, and gives some interesting data with regard to the materials used. The entire structural steel and metal work of bulkhead and piers is protected with Dixon's silica graphite paint.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., is now prepared to handle the very great increase in its business. The company has just completed the erection of two wings, the one jointly occupied by the pattern makers, brass makers and boxers, and the other occupied by the paint shop and power plant. The latter two departments are separated by a fire wall. The power plant contains two generating units. The larger carries the day load, and the smaller supplies the power required by the night shift. Incandescent lights are supplied by a motor-generator, which is operated by the direct current used in the shop, delivering alternating current for lights. The generators are of 200 kilowatts capacity, respectively, built by the Northern company, and are direct-connected to a 225-horse-power Vilter-Corliss engine, running at 100 revolutions per minute, in the first instance; and in the second instance, to a 75-horse-power Ball engine, at 290 revolutions per minute. Two 250-horse-power boilers supply steam for the operation of the plant, and the exhaust steam is used in heating the works.